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DIDYMODON (POTTIACEAE) IN MEXICO AND CALIFORNIA : TAXONOMY AND NOMENCLATURE OF DISCONTINUOUS AND NONDISCONTINUOUS TAXA¹

R.H. ZANDER *

ABSTRACT.— Eight species of *Didymodon* (Pottiaceae, Bryopsida), including thirteen varieties, are recognized for Mexico and California. New combinations include *Didymodon* sect. *Asteriscium* (C. Muell.), *D. rigidulus* var. *gracilis* (Schleich. ex Hook. & Grev.), *D. r.* var. *icmadophila* (Schimp. ex C. Muell.), *D. r.* var. *subulatus* (Thér. & Bartr. ex Bartr.), *D. australasiae* var. *umbrosus* (C. Muell.), *D. vinealis* var. *brachyphyllus* (Sull. in Whipple), *D. v.* var. *luridus* (Hornsch. in Spreng.), *D. v.* var. *nicholsonii* (Culm.) and *D. v.* var. *rubiginosus* (Mitt.). Thirty-five taxa are new synonyms. *Didymodon vinealis* var. *nicholsonii* is reported new to the New World. Unusually large concepts of certain taxa are presented. Whenever the names of these taxa are used by future bryologists, these and narrower taxonomic concepts of other authors should be clearly distinguished by indicating the concept «sensu» or «emendavit» a particular author and publication as part of the citation of the scientific name for precision in biological applications. An asynonymic method is used to provide scientific names for nondiscontinuous infraspecific taxa. Certain problems in typification of bryophytes are largely due to ease of making isotypes and of unmaking holotypes and lectotypes by past (and future) division of type specimens consisting of more than one gametophore.

The genus *Didymodon* Hedw. has long been a problem for bryologists because it is only poorly distinguished from *Barbula* Hedw. The species included in *Didymodon* are also often difficult to distinguish from each other, both because of apparent intra- and interspecific variation in morphology and because laminal papillae obscure the areolation (a character important to the «look» of a taxon under the microscope) in many species (one competent bryologist jocularly refers to gametophores of desert species of Pottiaceae as «black dot», anon., pers. comm.). I have discussed the differences between *Didymodon* and

1. I am grateful to the staff of the British Museum (Natural History), the Linnean Society of London, and the Conservatoire et Jardin botaniques, Genève, for initial permission and subsequent aid in study of the original collections of early botanists. Thanks are given to the curators of the herbaria mentioned in the text for loan of specimens. P.M. Eckel did the illustrations. This study was partially supported by a grant from the American Philosophical Society to the author.

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Barbula previously (ZANDER 1978a) and here attempt to render some solution to the former problem by recognizing only relatively discontinuous taxa as species (i.e. basic taxonomic units) and providing a nomenclatural system for dealing with nondiscontinuous taxa, and the latter problem by urging the use of Hoyer's Solution (ANDERSON 1954) rather than water for mounting specimens because it clarifies areolation.

The area of study is all of Mexico and the state of California in the U.S.A. Major floristic studies of these areas are by CRUM (1951) for the former and KOCH (1950) for the latter. Major regional taxonomic studies that include treatments of many of the species discussed here are by GROUT (1928-1940), STEERE (1938), BARTRAM (1949), LAWTON (1971) and FLOWERS (1973). This study was done to provide input of a specialist for the proposed moss floras of Mexico (ed. A.J. SHARP and H. CRUM, in prep.) and of California (D. NORRIS, in prep.). The sections labeled «Distribution» given with the discussions of taxa below refer only to Mexico and California. The descriptions are based on examined specimens from several herbaria: notably BM, BUF, FH, MICH, NY, PC, SPA, TENN and US. Complete lists of specimens examined are given for the few relatively rare taxa. The chromosome numbers cited are taken from the literature.

Both SAITO (1975) and ZANDER (1978a) assert that peristomes in *Didymodon* are rather variable in length in some species. Such statements usually refer only to the peristome of the deoperculate capsule. Although specimens with short opercula have short peristomes, some specimens with long opercula have long, but highly fragmented peristome teeth when observed in cleared operculate capsules – these teeth would appear short when the operculum, together with the distal peristome fragments, is removed. A morphological feature not previously seen in *Didymodon* is the presence of transverse slits in the medial basal portion of the leaves on both sides of the costa of some specimens of *D. australasiae* var. *umbrosus*. Such slits – resorption channels reaching across several cells and perforating the leaf – have been previously noted in *Kingobryum paramicola* Robins. (Dicranaceae) (ROBINSON 1967; ZANDER & CLEEF, in prep.) and simply perforate basal cells have been described for a few Pottiaceae species by PROCTOR (1979).

The systematic framework presented here is a model reflecting what are thought to be natural relationships of taxa inferred from observations on a series of specimens. There are no arbitrary limits given to the taxa so future workers may easily test the model and perhaps better it. Some may question the possible advantage of reducing to varietal status many names that have been in use at the species level in Europe and North America. First, I affirm that the present taxonomic scheme accurately reflects the inferred relationships of *Didymodon* taxa in Mexico and California – there is no borrowing of European concepts. Second, the concepts accepted are quite similar, albeit at different taxonomic levels, to those in modern European identification manuals and may represent parallel speciative relationships. Third, this exercise in «lumping» has demonstrated what are surely real, biologically-based relationships between many pre-

vously poorly understood taxa and have brought some order to *Barbula* sensu lato of recent manuals.

Varieties of *Didymodon* species are here presented as intergrading in several characters. It may be argued that closely related species might also be expected to show this. However, there are no clear discontinuities between most varieties in the species treated here and a major inference in this paper is that many species normally consist of pairs (or trios, etc.) of intergrading variants usually sympatric in a major portion of the species' range and disjunctive as colligations. Such varietal groups may be simply disparate in extreme form (e. g. *D. australasiae* varieties) or may form parallel gradients in plant size and morphology (e. g. *D. vinealis* varieties).

There are three nomenclatural inadequacies of the International Code of Botanical Nomenclature (STAPLEU et al. 1978) that have made this treatment of *Didymodon* difficult in execution and needful of unusual solutions. First, as most taxonomists are well aware, the I.C.B.N. provides rules that are intended to stabilize usage of names, not to provide different names for differing concepts of individual taxa. This may become a problem in cases when taxonomists' concepts of taxa differ widely although including the same types. Here, several species are recognized as vastly larger concepts than are usually held. This may be a source of some ill ease on the part of other bryologists who now must determine if an annotation of one such species name on an herbarium specimen is «sensu Zander (this paper)» or sensu earlier authors. Certainly, unless this distinction is clear, bryologists who favor narrow species limits in *Didymodon* will perceive a chaotic situation in the herbarium. This problem is not just related to the size of the taxon recognized but also to the characters by which taxa are recognized. For instance, from descriptions, *Barbula icmadophila* (treated here as *Didymodon rigidulus* var. *icmadophila*) sensu NYHOLM (1956) is quite different from *Barbula icmadophila* sensu STEERE (1938) or SAITO (1975). Also, various authors have emphasized rather different characters in their circumscriptions of *Didymodon rigidulus*. But, for each of these concepts, the type specimens and, therefore, the scientific name remains the same. At the generic level, *Barbula* Hedw. sensu NYHOLM (1956) and *Barbula* Hedw. sensu SAITO (1975) are rather different concepts although the generic type is the same. One might also note that the name *Mnium* Hedw. is now inexact as far as its significance to biology is concerned unless one designates whether it is to be used in the sense of KOPONEN (1968) or of earlier (and some later) authors. The same is true of *Polytrichum* Hedw. (sensu SMITH 1971, or of earlier and some later authors). In fact, stable names for taxa in conceptually changing taxonomic frameworks result in confusion unless differing concepts are identified individually. There are no means for distinguishing between different taxonomic concepts that have the same scientific name unless such concepts are cited as «sensu» or «emendavit» (Article 47A, I.C.B.N.) the author responsible for the concept.

Second, implicit in the I.C.B.N. is the assumption that all taxa are discontinuous. Most taxonomists «follow the rules» and make the best of it, but HES-

LOP-HARRISON (1960) has stated quite correctly that «clinal variation, but its very nature, is untreatable by taxonomic methods which demand the recognition of «types»». Nondiscontinuous taxa, intergrading in morphological characters, are assigned scientific names on the present paper by an unusual method that does not, however, contravene provisions of the I.C.B.N. The usual revisionary nomenclatural treatment is to divide all synonyms of the species *s. lat.* among the infraspecific taxa recognized and then determine priority of publication of legitimate names in each set of synonyms to find the correct name of each infraspecific taxon. Since such initial segregation of synonyms is impossible or at least arbitrary for what are apparently nondiscontinuous taxa, the scientific name for each such infraspecific taxon is here based on the earliest legitimate name among all synonyms of the species *s. lat.* with a type specimen clearly representative of (or «within») the nondiscontinuous infraspecific concept recognized. Of course, such names are selected first from those at the taxonomic level recognized, and the type of the typical variety (or other taxonomic category) must be included among the correct names of the infraspecific taxa recognized. All other heterotypic names are then simply left as synonyms of the species *s. lat.* Additional discussion, with examples, is given in the treatment of *Didymodon rigidulus* below.

The intergrading infraspecific taxa recognized in this paper are somewhat similar to HERZOG's (1907) «Idealtypen» of the collective species *Trichostomum mutabile* Bruch (= *T. brachydontium* Bruch in F.A. Muell.). He recognized four informal names for arbitrarily circumscribed intergrading variants along a morphological cline from large to small stature plants (involving several characters) that paralleled a north to south cline in distribution of the species in Europe. The taxonomic scheme used here would treat the variants of the same collective species in a non-arbitrary fashion, recognizing the large and small ends of the cline as biological phenomena worthy of names and using a monotypic method of providing scientific names for them. Informal names as used by HERZOG (1907) have never proved popular, and the I.C.B.N. should be used if at all possible in modern taxonomic studies to provide a bridge between alpha taxonomists and concept-oriented experimentalists and biosystematists. Also, for the biologist, there is no shame and certainly much value in appending «aff.» (= *affinis*) before an epithet in an identification on an herbarium label when in fact the taxon, though often clearly marked, is definitely perceived by a revisionist to be open-ended, intergrading with another taxon.

Third, ISOVIITA's (1966) statement «...the section on typification in the present Code allows excessive freedom of interpretation in many cases...» is still true. The Guide for the Determination of Types is extraordinarily vague and anyone's attempt at lectotypification may be challenged by a later worker with different opinions. Because types of bryophyte names may consist of many plants (or gametophores), any designation of holotype or lectotype may be obviated by the subsequent division of the plants in a packet, or by the discovery somewhere of an additional isotype not seen during previous lectotypification(s). If, for example, three different bryologists have proposed three different lectotypes for the same scientific name of a taxon, whom does one follow? The

one who is best called a «specialist»? The one whose lectotypification was most «scientific»? The one who saw the most isotypes? Although designation of a single gametophore as lectotype might solve some problems, identification necessarily involving dissection then becomes hazardous or inappropriate. It may well be that lectotypification of very early scientific names that involve many, scattered, poorly labeled isosyntypes may ultimately have to involve conservation of type specimens, now not provided for in the I.C.B.N. The discussion of *Didymodon vinealis* var. *luridus*, below, gives examples of problems in typification in part due to the ease of creating isotypes and of obviating designations of holotypes and lectotypes by division of a type specimen of more than one gametophore, or the discovery of such at a later date. A recent review and discussion of problems in typification of early bryophyte names is given by KOPONEN (1979), and VITT (1981) has typified the species of *Macrocoma* (Orthotrichaceae) exhaustively in a modern fashion.

SYNOPSIS OF TAXA OF *DIDYMODON* IN MEXICO AND CALIFORNIA

Didymodon Hedw. sect. *Didymodon*

D. incrassatolimbatus Card.

D. rigidulus Hedw. emend. Zander

var. *rigidulus*

var. *gracilis* (Schleich. ex Hook. & Grev.) Zander

var. *icmadophila* (Schimp. ex C. Muell.) Zander

var. *subulatus* (Thér. & Bartr. ex Bartr.) Zander

Didymodon sect. *Asteriscium* (C. Muell.) Zander, comb. nov.*

D. australasiae (Hook. & Grev.) Zander emend. Zander

var. *australasiae*

var. *umbrosus* (C. Muell.) Zander

D. revolutus (Card.) Williams

Didymodon sect. *Fallaces* (De Not.) Zander

D. fallax Hedw.

var. *reflexus* (Brid.) Zander

D. michiganensis (Steere) Saito

D. tophaceus (Brid.) Lisa

Didymodon sect. *Vineales* (Steere) Zander

D. vinealis (Brid.) Zander emend. Zander

var. *vinealis*

var. *brachyphyllus* (Sull. in Whipl.) Zander

var. *luridus* (Hornsch. in Spreng.) Zander

var. *nicholsonii* (Culm.) Zander

var. *rubiginosus* (Mitt.) Zander

var. *flaccidus* (B.S.G.) Zander

* *Barbula* sect. *Asteriscium* C. Muell., *Limnag.* 42 : 342. 1879, basionym. — *Asteriscium* (C. Muell.) Hilp., *Beih. Bot. Centralbl.* 50 (2) : 618. 1935, hom. illeg. non *Asteriscium* Charn. & Schlecht., 1826. — *Didymodon* sect. *Craspedophyllum* Card., *Rev. Bryol.* 36 : 81. 1909, syn. nov.

Descriptions of sect. *Didymodon*, sect. *Vineales* and sect. *Fallaces* (as sect. *Graciles*, synonym fide ZANDER 1979) are provided by ZANDER 1978a. Section *Asteriscium* is characterized by the leaves spreading to spreading-recurved when moist, broadly channelled; leaf margins not decurrent, plane to broadly recurved throughout; costa ending 1-6 cells below apex to short-excurrent, often rather broad at midleaf, adaxial surface convex; upper laminal cells unistratose to evenly or in patches bistratose along the leaf margins, papillae absent to large, low, simple to bifid 1(-4) per cell lumen each side; adaxial surficial cells of costa quadrate to elongate, adaxial stereid band absent, hydroid (Begleiter cell) groups often present between guide cells and abaxial stereid band; stem occasionally with hyalodermis.

DIDYMODON HEDW., Spec. Musc. : 104. 1801

Generitype : *D. rigidulus* Hedw.

Husnotiella Card., Rev. Bryol. 36 : 71. 1909. **Type** : *D. revolutus* Card.

Trichostomopsis Card., Rev. Bryol. 36 : 73. 1909. **Type** : *T. crispifolia* Card.

For additional synonymy see SAITO (1975).

Plants forming cushions or turf, light to dark green or olive-green. **Stems** mostly to 2(-6) cm long, central strand present, occasionally very strong, axillary hairs usually with 1-2 brown basal cells. **Leaves** ovate to long-lanceolate or long-triangular, ventrally usually broadly concave, occasionally somewhat channelled along the costa above midleaf, margins entire or occasionally weakly dentate or crenulate, plane to recurved or revolute, leaf apex rounded to narrowly acute, leaf base weakly differentiated to oblong and half-sheathing the stem; costa ending several cells below the leaf apex to long-excurrent, ad- and abaxial surficial cells quadrate to elongate, smooth or occasionally papillose; costa in transverse section ovate, semicircular or reniform, epidermal layers differentiated, adaxial stereid band present, absent or represented by a layer of large-lumened substereid cells, guide cells 2-4, hydroids (Begleiter cells) seldom present, dorsal stereid band usually weak; **upper laminal cells** subquadrate to rounded-angular, occasionally short-rectangular or rhomboidal, walls thin to evenly or unevenly thickened, usually bulging surficially on both surfaces, laminal papillae often absent, usually solid, simple to bifid, centered over the lumens to apparently scattered; **basal laminal cells** not or weakly differentiated to strongly differentiated, quadrate to rectangular, smooth to weakly papillose. **Propagula** occasionally present, usually spherical to elliptical, of 1-10 cells. **Dioicous** (some species possibly rhizautoicous). **Gametoecia** terminal, perigonia gemmate; perichaetial leaves ovate to long-lanceolate, often enlarged, often loosely sheathing the seta, laminal cells usually prosenchymatous to above mid-leaf. **Sporophyte seta** elongate, twisted clockwise below, occasionally counter-clockwise above; **theca** ovate to long-cylindrical; stomata at base of theca, phaneropore; annulus of 1-3 rows of weakly to strongly vesiculose cells, not deciduous; **peristome** rudimentary or short, occasionally long and twisted, of

16 short teeth or 32 triangular to linear rami, usually densely spiculose, occasionally spiral-striate or papillose, basal membrane absent or low; **operculum** short- to long-conic or conic-rostrate. **Calyptra** cucullate, smooth. **Laminal color reactions** (after clearing in concentrated lactic acid) : Cl (conc. HCl) - green + light to medium yellow-brown, occasionally light to medium orange-brown, rarely deep yellow or orange; K (10% KOH) - usually light to medium yellow-brown or light to deep red-brown or red-orange-brown, occasionally light to deep red, orange or yellow-orange, or light brown; N (conc. HNO_3) - light yellow-brown or light to medium red-brown or red-orange-brown, occasionally light brown or medium orange; SE (H_2SO_4 -ethanol, 2:1) - green + deep red or red-orange-brown, occasionally medium orange-brown.

KEY TO SPECIES OF *DIDYMODON* IN MEXICO AND CALIFORNIA

1. Leaves with elongate upper adaxial costal cells 2.
1. Leaves with quadrate (occasionally short-rectangular) upper adaxial costal cells 5.
2. Upper laminal cells short-rectangular, upper laminal margins bistratose *D. australasiae* (Hook. & Grev.) Zander, p.p.
2. Upper laminal cells subquadrate to rhomboidal, upper laminal margins unistratose 3.
3. Hygrophyte; leaves ovate to long-elliptical, apex obtuse to acute, basal margins usually broadly decurrent, costa ending before the apex to short-excurrent, upper laminal cells often short-rectangular to elongate-rhomboidal *D. tophaceus* (Brid.) Lisa
3. Mesophyte; leaves short- to long-lanceolate, apex acute, basal margins short and broadly decurrent to little decurrent, costa percurrent to short-excurrent, upper laminal cells mostly ovate to subquadrate 4.
4. Leaves catenulate when dry, not keeled or recurved when moist, basal margins strongly recurved, upper laminal cells in very distinctive longitudinal rows, propagula often present. *D. michiganensis* (Steere) K. Saito
4. Leaves appressed to weakly spreading when dry, usually recurved and keeled when moist, basal margins weakly recurved, upper laminal cells in weakly differentiated longitudinal rows, propagula absent *D. fallax* (Hedw.) Zander
5. Median basal laminal cells strongly differentiated, thin-walled, hyaline, often inflated or transversely elongate, costa often with hydroids (Begleiter cells), and adaxial stereid band absent; leaf apex usually broadly acute and weakly cucullate; stem often with hyalodermis; plants often black-green *D. australasiae* (Hook. & Grev.) Zander, p.p.
5. Median basal laminal cells (if differentiated from upper laminal cells) weakly differentiated, with thin to evenly thickened walls, costa lacking hydroids (except *D. revolutus*), adaxial stereid band often present; leaf apex not or little cucullate, stem lacking hyalodermis; plants olive to light green 6.
6. Leaves short-ovate, costa spurred, wide, to 8 adaxial epidermal costal

- cells across at midleaf, margins strongly recurved to revolute to near apex; propagula, when present, unicellular; peristome absent to rudimentary *D. revolutus* (Card.) Williams
6. Leaves ovate to long-lanceolate, costa not spurred, narrower, 2-6 adaxial epidermal costal cells across at midleaf, margins plane or recurved below or to above midleaf; propagula mostly multicellular; peristome rudimentary to well-developed 7.
7. Leaves usually yellowish-green at high magnification, usually narrowly channelled adaxially along costa near apex, costa evenly thick to apex, 5-6 adaxial epidermal costal cells across at midleaf (in large plants at least), percurrent to short-excurrent in a conical mucro, adaxial stereid band usually represented by substereid cells, guide cells often in 2-3 layers, upper laminal cell walls thin to evenly thickened, lumens subquadrate, papillae often present, bifid or multiplex and flattened; propagula seldom present. *D. vinealis* (Brid.) Zander
7. Leaves usually bluish-green at high magnification, plane to broadly channelled adaxially near leaf apex; costa narrowing to apex, 2-4 adaxial epidermal costal cells across at midleaf, percurrent to strongly excurrent as a cylindrical mucro, adaxial stereid band absent or present, guide cells in one layer, upper laminal cell walls thin to unevenly thickened, lumens subquadrate to oval or many-sided, papillae when present usually simple, seldom bifid; propagula often present 8.
8. Peristome of long-triangular, red-orange, spirally striate or finely spiculate to low-papillose teeth; leaves long-triangular to ovate-lanceolate, gradually narrowed above, laminal margins evenly bistratose from midleaf to apex, upper laminal cells heterogeneous in size and shape *D. incrassatolimbatus* Card.
8. Peristome of long-linear (or occasionally ovate, rudimentary), yellow or orange, densely and strongly spiculate teeth; leaves ovate-lanceolate to narrowly lanceolate, usually acuminate, laminal margins unistratose or bistratose near apex or in patches to midleaf, upper laminal cells homogeneous in size and shape *D. rigidulus* Hedw.

1. **DIDYMODON INCRASSATOLIMBATUS CARD.**, *Rev. Bryol.* 36 : 81. 1909.

Type : Mexico, Distrito Federal, Cañada, Pringle 10588 (PC - lectotype; BM, FH, NY - isotypes); Michoacán, Patzcuaro, Pringle 748 (FH, BM, PC - isosyntypes).

Plants forming cushions, green, yellow-green or olive-green above, brown to reddish-brown below. **Stems** with few branches, brown, to 1.0-(2.0) cm long, rounded pentagonal in transverse section, central strand usually strong, cortical cells smaller, with walls thin or slightly thickened or cortex little differentiated, hyalodermis absent; axillary hairs of 3-5 uniseriate cells, basal cell brown. **Leaves** when dry appressed to laxly spreading, when wet widely spreading 45-90°, ovate-lanceolate to long-triangular, (1.5-)2.0-2.5 mm long, adaxial surface

broadly and weakly convex; leaf margins recurved basally or to midleaf, entire, 2(-4)-stratose along upper margins and in patches in medial portion of lamina; leaf apex acute; leaf base scarcely differentiated to short-ovate, margins not or shortly decurrent; costa percurrent to short-excurrent, ad- and abaxial surficial cells quadrate, in 5-6 rows adaxially at midleaf, transverse section of costa flattened-semicircular, adaxial surface weakly concave to weakly convex, adaxial stereid band weak or absent, ad- and abaxial epidermal cells differentiated in one layer, lumens of abaxial epidermal cells oval, guide cells 2-4 in one layer, hydroids absent; **upper laminal cells** hexagonal to subquadrate, occasionally reniform, 6-8 μm wide, 1:1, walls thin to evenly thickened, often wavy, superficially bulging, not organized in a distinct pattern, heterogeneous in size and shape; laminal papillae usually absent, occasionally weakly differentiated, low lenses, 1(-2) per lumen per size; **basal laminal cells** differentiated medially, rectangular to rhomboidal, to 15 μm wide, 2-4:1, walls thin, hyaline. Propagula not seen. Apparently dioicous, perigonia not seen. **Perichaetia** terminal, inner leaves ovate-lanceolate, 2.0-2.9 mm long, sheathing the seta below, prosenchymatous near base. **Sporophyte seta** 1(-2) per perichaetium, 0.9-1.0 mm long, orange-brown, twisted clockwise; **theca** 1.5-2.3 mm long, orange- or yellow-brown, weakly sulcate when dry, long-elliptical to long-cylindrical, occasionally curved, neck weakly differentiated, exothelial cells rectangular, 25-30 μm wide, 3-5:1, walls thin; stomates phaneropore, at base of theca; annulus of one layer of vesiculose cells; **peristome** of 16 long-triangular, red- to yellow-orange teeth, 270-450 μm long, straight or weakly twisted counterclockwise, spirally striate or low papillose to finely spiculose, with several articulations, basal membrane low or absent; **operculum** long-conic to conic-rostrate, 0.5-0.7 mm long, cells weakly twisted counterclockwise. **Calyptra** cucullate, smooth, ca. 2 mm long. **Spores** light brown, weakly papillose, (7-)10-12(-15) μm in diameter. **Laminal color reactions** (after clearing in conc. lactic acid): Cl (conc. HCl) - green + light yellow-brown; K (10% KOH) - medium orange-brown, occasionally red-orange-brown; N (conc. HNO_3) - light yellow-brown to red-brown; SE (conc. H_2SO_4 -ethanol, 2:1) - green + deep red. **Illustration**: Pl. I, fig. 1-5.

Didymodon incrassatolimbat differs from the very similar taxon *D. vinealis* var. *nicholsonii* by the short-excurrent costa, costal transverse section with adaxial stereid band, leaf apex only weakly channelled, perichaetial leaves ovate-lanceolate, and peristome red-orange, of long-triangular teeth. *Didymodon australasiae* var. *australasiae* is also similar in appearance, but can be distinguished by the characters emphasized in the Key to Species. The syntype (Mexico, Pringle 748) of *D. incrassatolimbat* is *Didymodon rigidulus* var. *subulatus*.

Habitat: rock, soil, wet areas, riverside, occasionally submerged.

Distribution: Mexico: Distrito Federal, México, Michoacán, Morelos.

Range: endemic to Mexico.

Specimens examined: Mexico. Distrito Federal: Tlalpan, Amable 1349 (NY); Cañada, above Contreras, Pringle 10556 (FH), 10588 (BM, FH, NY), Barnes & Land 442 (NY). México: 3 km E of San Rafael, Cárdenas 47 (MEXU, TENN).



Pl. 1. — 1-5 : *Didymodon incrassatolimbatus*. 1-2 : Leaves. 3 : Leaf apex. 4 : Upper marginal cells. 5 : Transverse section. 6 : Capsules. 7-10 : *D. rigidulus* var. *rigidulus*. 7-8 : Leaves. 9 : Leaf apex, note bistratose cells easily seen on edge at margins. 10 : Propagula. Magnifications : leaves $\times 43$; leaf apices, upper marginal cells, transverse sections $\times 100$; propagula $\times 100$; capsules and peristomes $\times 28$.

Michoacán : Morelia, Loma Santa María, Arsène 4866 (FH); Rincón, Arsène 4567 (FH); Morelos, Zempoala, 3.5 km from Tres Cubres, road to Cuernavaca, Patrick 237 (TENN).

2. *DIDYMODON RIGIDULUS* HEDW. EMEND. ZANDER, Spec. Musc. : 104. 1801.

Trichostomum rigidulum (Hedw.) Turn., Musc. Hib. : 34. 1804. — *Barbula rigidula* (Hedw.) Milde, Bryol. Siles. : 118. 1863. — *Tortula rigidula* (Hedw.) Lindb., Oefv. K. Vet. Ak. Foerh. 21 (4) : 249. 1864.

Tortula acuta Brid., Musc. Recent. Suppl. 1 : 265. 1806. — *Barbula acuta* (Brid.) Brid., Mant. Musc. : 96. 1819 — *Didymodon acutus* (Brid.) Saito, J. Hattori Bot. Lab. 39 : 519. 1975.

Barbula teretiuscula Schimp. ex C. Muell., Syn. Musc. 1 : 614. 1849, syn. nov.

Type : Mexico, Veracruz, «ad montem Orizaba, Liebmann» (BM - isotype). — *Tortula teretiuscula* (Schimp. ex C. Muell.) Mitt., J. Linn. Soc. Bot. 12 : 160. 1869.

Barbula mobilis C. Muell., Linnaea 42 : 482. 1879, syn. nov. **Type** : Venezuela, Fendler, 1855 (NY - isotype).

Barbula flaccidiseta Lor., Moosst. : 161. 1864, syn. nov. **Type** : Mexico, México, Schmitz s. n. (BM, NY - isotypes).

Barbula graciliformis Schimp. ex Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 179. 1872, syn. nov. **Type** : Mexico, Distrito Federal, San Nicolas, Bourgeau 1355 (PC - lectotype, BM - isotype).

Didymodon mexicanus Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 172. 1872, syn. nov. **Type** : Mexico, Bourgeau, 27 Sept. 1865 (BM, NY - isotypes). — *Trichostomum mexicanum* (Besch.) C. Muell., Gen. Musc. Frond. : 420. 1900.

Barbula leptocarpa Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 179. 1879, syn. nov. **Type** : Mexico, Veracruz, Orizaba, Bourgeau s. n. (BM, PC - isotypes).

Barbula rigidula Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 180. 1872, hom. illeg. non *B. rigidula* (Hedw.) Mild., 1863; syn. nov. **Type** : Mexico, Distrito Federal, Guadalupe, Bourgeau 1321 (PC - lectotype, NY - isotype).

Barbula erythropoda Schimp. ex Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 180. 1872, syn. nov. **Type** : Mexico, San Cristobal, Mueller s. n. (NY, PC - isotypes).

Barbula gracilescens Schimp. ex Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 178. 1872, syn. nov. **Type** : Mexico, Veracruz, Mueller, 1853 (BM - holotype).

Trichostomum ramulosum Schimp. ex Besch., Mém. Soc. Nat. Sci. Nat. Cherb. 16 : 177. 1872, syn. nov. **Type** : Mexico, Mueller s. n. (BM - isotype). — *Didymodon ramulosus* (Schimp. ex Besch.) Card., Rev. Bryol. 36 : 82. 1909.

Barbula bescherellei Sauerb. in Jaeg., Ber. S. Gall. Naturw. Ges. 1877-78 : 409. 1880 (Ad. 2 : 673), nom. nov. for *B. rigidula* Besch., 1872, hom. illeg. — *Barbula acuta* var. *bescherellei* (Sauerb. in Jaeg.) Crum, Bryologist 72 : 241. 1969.

Barbula lagunicola C. Muell., Bull. Herb. Boiss. 5 : 194. 1897, syn. nov. **Type** : Guatemala, Laguna del Pino, Tuerkheim 114 (NY).

- Barbula godmaniana* C. Muell., *Bull. Herb. Boiss.* 5 : 193. 1897, syn. nov.
Type : Guatemala, Volcan de Fuego, Godman & Salvin (NY, SPA - isosyntypes). - *Didymodon godmanianus* (C. Muell.) Bartr., *Bryologist* 49 : 113. 1946.
- Barbula strictidens* C. Muell., *Bull. Herb. Boiss.* 5 : 193. 1897, syn. nov.
Type : Guatemala, Laguna del Pinar, Tuerkheim 113 (NY - isotype).
- Barbula subteretiiscula* Card., *Rev. Bryol.* 36 : 85. 1909, syn. nov. **Type** : Mexico, Hidalgo, Cuzamaloza, Pringle 10621 (PC - lectotype; FH, TENN - isotypes).
- Barbula altiseta* Card., *Rev. Bryol.* 36 : 85. 1909, syn. nov. **Type** : Mexico, Michoacán, Patzcuaro, Pringle 751 (PC - lectotype; BM, FH, TENN - isotypes).
- Didymodon fuscoviridis* Card., *Rev. Bryol.* 36 : 83. 1909, syn. nov. **Type** : Mexico, Veracruz, Maltrata, Trelease, 1905 (PC - holotype).
- Didymodon viridissimus* Card., *Rev. Bryol.* 36 : 82. 1909, syn. nov. **Type** : Mexico, Jalisco, Barranca de Guadalajara, Pringle 15227 (PC - lectotype, NY - isotype).
- Didymodon pusillus* Card., *Rev. Bryol.* 36 : 82. 1909, hom. illeg. non *D. pusillus* Hedw., 1801; syn. nov. **Type** : Mexico, Jalisco, Guadalajara, Pringle 10574 (PC - holotype).
- Barbula bescherellei* var. *stenocarpa* Card., *Rev. Bryol.* 37 : 126. 1910, syn. nov. **Type** : Mexico, México, Ixtaccihuatl, Purpus 3716 (PC - lectotype); Distrito Federal, Cima, Barnes & Land 390 (NY, PC - isosyntypes); Cañada, San Magdalena, Barnes & Land 161 (NY, PC - isosyntypes).
- Didymodon heribaudii* Card., *Rev. Bryol.* 40 : 35. 1913, syn. nov. **Type** : Puebla, Rancho Posada, Nicolas 5976 (PC - lectotype, BM, NY - isotypes).
- Barbula bescherellei* var. *crassinervia* Thér., *Smiths. Misc. Coll.* 85 (4) : 17. 1931, syn. nov. **Type** : Mexico, Distrito Federal, Mixcoac, Arsène 9470 (PC - syntype), 9473 (FH - syntype).

Plants forming cushions or turf, green to dark or blackish green above, light to dark brown below. **Stems** irregularly and seldom branching, light brown to red-brown, mostly 1-2 cm long, in transverse section rounded-pentagonal, central strand usually very strong, cortex of thick-walled cells with small lumens, seldom not differentiated, hyalodermis absent or rarely weakly distinguishable in patches; axillary hairs of 3-7 uniseriate cells, basal 1(-2) cells brown. **Leaves** when dry appressed to weakly spreading, when wet weakly to widely spreading, ovate- to long-lanceolate, 0.8-1.9(-3.0) mm long, adaxial surface broadly channelled across leaf; leaf margins usually narrowly recurved in lower 1/2-3/4, entire, unistratose or bistratose evenly or in patches above midleaf; leaf apex obtuse to acuminate, occasionally entirely bistratose, occasionally bearing rhizoids; leaf base scarcely differentiated to ovate or oblong, basal margins not or shortly and narrowly decurrent; costa percurrent to long-excurrent as a cylindrical, sharp subula, often flexuose, ad- and abaxial surficial cells quadrate above midleaf, usually smooth, in 2-5(-6) longitudinal rows at midleaf, transverse section of costa reniform to elliptical, adaxial surface usually convex, ad- and

abaxial steroid bands usually present but weak, ad- and abaxial epidermal cells present in one layer, abaxial lumens oval, guide cells 2-4 in one layer, hydroids absent; **upper laminal cells** subquadrate to hexagonal, (5-)7-9(-12) μm wide, 1:1, walls evenly thickened to thicker at the cell corners, surficially bulging, often only abaxially, lumens rounded-quadrate to oval, arranged in distinct longitudinal rows, homogeneous in size and shape; laminal papillae absent to simple or bifid, often appearing as low lenses, 1-2 per lumen on each side or only abaxially, usually appearing centered over the lumens, occasionally fused in longitudinal rows; **basal laminal cells** not differentiated or weakly differentiated, quadrate to short-rectangular, 7-12(-36) μm wide, 1-4:1, walls evenly thickened, occasionally thin. **Propagula** often present, ovate to elliptical, green to brown, of mostly 3-8 cells, borne on rhizoids in leaf axils. **Dioicous**; **perichaetia** terminal, inner leaves scarcely differentiated to long-lanceolate, to 1.9-2.7 mm long, often loosely sheathing the seta, prosenchymatous in lower 1/4-3/4; perigonia terminal, often in series, on equal-sized or smaller gametophores, gemmate. **Sporophyte seta** 1(-2) per perichaetium, 0.7-1.7 mm long, red-brown to yellow, twisted clockwise, occasionally also counterclockwise above; **theca** 1.0-2.1 mm long, red-brown, smooth when dry, long-elliptical to cylindrical, occasionally ovoid or curved, neck weakly differentiated; exothelial cells rectangular, 18-35 μm wide, 4-5:1, walls evenly thickened or thin; stomates at base of theca, phaneropore; annulus of 1-3 rows of weakly to strongly vesiculose cells; **peristome** of 16 rudimentary teeth or 32 filamentous rami, 180-740 μm long, yellow-brown, occasionally orange, straight to twisted to 1.5 times, usually densely spiculose, occasionally granulose, basal membrane low, 15-30 μm high, or absent, spiculose or papillose; **operculum** long-conic to conic-rostrate, 0.4-0.9 (-1.5) mm long, cells not or weakly twisted counterclockwise. **Calyptra** cucullate, smooth, 1.7-2.8 mm long. **Spores** brown to yellow-brown, smooth, 9-12(-15) μm in diameter. $n = 12, 13$. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green + light yellow-brown, seldom medium orange; K (10% KOH) - light to dark orange, occasionally red- to yellow-orange, seldom light red-brown; N (conc. HNO_3) - light yellow- to orange-brown, occasionally red-orange-brown, yellow-orange or orange; SE (conc. H_2SO_4 -ethanol, 2:1) - green + dark red-orange-brown or dark red. **Illustrations** : Pl. I, fig. 7-10; Pl. II, fig. 1-14.

Didymodon rigidulus is distinguishable from *D. vinealis* often only with great difficulty. All relevant characters emphasized in the above Key to Species must be carefully evaluated because various character states may be poorly expressed in examined specimens.

Habitat : soil, gravel, acidic and calcareous rock, walls, occasionally bark, moist or dry situation, 900-3600 m elevation.

Distribution : Mexico : Baja California, Baja California Sur, Chiapas, Chihuahua, Coahuila, Distrito Federal, Hidalgo, Jalisco, México, Michoacán, Morelos, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sonora, Tamaulipas, Tlaxcala, Veracruz, Zacatecas; widespread in California.

Range : nearly worldwide, but in tropical areas mainly found at high elevations.

I here provide a key and columbariate names (those to which heterotypic synonyms cannot be assigned with confidence - ZANDER 1978a) at the varietal level for those bryologists who may wish to assign their collections to «pigeonholes» corresponding to (1) concepts of these taxa that may be valid in some areas of the world but are not discontinuous in Mexico and California, or (2) to local variants that are of unusual morphology in some specimens.

Key to Varieties of *Didymodon rigidulus* Hedw. in Mexico and California

1. Peristome teeth rudimentary; entire upper lamina evenly bistratose.
 var. *subulatus* (Bartr.) Zander
1. Peristome teeth short and straight to long and twisted; leaf apex or leaf margins unistratose or bistratose, but medial cells unistratose. 2.
 2. Leaves long-elliptical to long-triangular, costa usually short-excurrent, leaf apex and upper margins usually bistratose; propagula commonly present
 var. *rigidulus*
 2. Leaves lanceolate, costa percurrent to long-excurrent, upper laminal margins occasionally bistratose in patches; propagula commonly absent . . . 3.
3. Leaves short-lanceolate to long-lanceolate, leaf base not sharply dilated, rounded-square to rectangular, costa percurrent to long-excurrent as a rigid awn, upper laminal cells commonly papillose, lumens oval or rounded-quadrate, basal cells short-rectangular; propagula occasionally present.
 var. *gracilis* (Hook. & Grev.) Zander
3. Leaves long-lanceolate, leaf base sharply dilated, oval, costa long-excurrent as an often flexuose or fragile awn, upper laminal cells usually smooth, lumens usually angular, basal cells usually quadrate; propagula absent
 var. *icmadophila* (C. Muell.) Zander

— *Didymodon rigidulus* Hedw. var. *rigidulus*

Leaves long-elliptical to long-triangular, occasionally broadly ovate-lanceolate, to 2.5 mm long, leaf base weakly differentiated to rectangular, upper margins usually recurved, usually bistratose evenly or in long patches, lamina near apex often completely bistratose; costa usually short-excurrent as a thick, blunt mucro, upper laminal cells usually papillose, basal laminal cells rectangular; propagula commonly present; peristome teeth short and straight to weakly twisted. **Illustration** : Pl. 1, fig. 7-10.

The var. *rigidulus* is relatively stenotypic in eastern North America, having characteristic features of weakly spreading leaves, broad leaf apex, evenly bistratose leaf margins and apex, short-excurrent to percurrent costa, and leaf cells with rather thick walls. It intergrades with the other varieties, however, in western North America. A specimen from eastern United States (New York, Zander 4635 - BUF) with the above morphology, when cultivated at BUF in a humid environment, produced branches with new leaves that approached somewhat the morphology of those of var. *gracilis*; they were strongly recurved, the apex was narrowly acute, the leaf margins were bistratose only in occasional

patches, the lamina at the apex was unistratose, the costa was short-excurrent, and the upper laminal cell walls were thin. It is evident that some collections of *D. rigidulus* var. *rigidulus*, under certain environmental conditions, may grow to look similar to var. *gracilis*. The degree to which morphological characteristics of the varieties and of particular collections of *D. rigidulus* are stable under changing environmental conditions is unknown, and broadly based studies are important for adequate biological evaluation of the elements here treated as varieties.

Habitat : soil, calcareous rock, moist areas, 900-2500 m elevation.

Distribution : Mexico : Baja California, Michoacán, Puebla and Veracruz.

Range : North and South America, Europe, northern Africa and Asia.

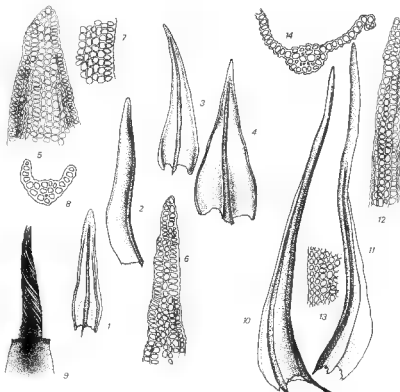
— *Didymodon rigidulus* var. *gracilis* (Schleich. ex Hook. & Grev.) Zander, comb. & stat. nov.

Tortula gracilis Schleich. ex Hook. & Grev., *Edinburgh J. Sci.* 1 : 300. 1824, basionym, nom. nov. for *Barbula gracilis* Schwaegr., *Spec. Musc. Suppl.* 1(1) : 125. 1811, hom. illeg. non *B. gracilis* Schum., 1803.

Leaves short- to long-lanceolate, 0.8-1.5(-3.0) mm long, leaf base not strongly differentiated, rounded-square to rectangular, upper margins plane or recurved, uni- or bistratose in patches, costa subpercurrent to long-excurrent as a rigid awn, upper laminal cells commonly smooth, basal cells short-rectangular, propagula occasionally present; peristome teeth short and straight to long and twisted. **Illustration** : Pl. II, fig. 1-9.

Barbula gracilis has long been considered a later synonym of the more familiar *B. acuta* (Brid.) Brid.; however, the appropriate combination of the latter is preoccupied by *Didymodon rigidulus* var. *acutus* Biz. Although nomenclatural synonymy of the first two names is here avoided for reasons discussed below, the names are, historically, conceptual synonyms. There are no available varietal names that unambiguously refer to the taxon described above, and a new status is given the epithet *gracilis*.

DIXON (1924) and SMITH (1978, as *B. acuta*) noted the occasional presence of propagula in var. *gracilis*, while other major authors did not and considered the presence of propagula a diagnostic characteristic of var. *rigidulus* (as *D. rigidulus* s. str.). CRUNDWELL and NYHOLM (1965) «reluctantly» synonymized the European species *Barbula valida* (Limpr.) Moell. with var. *gracilis* (as *B. acuta*), noting correlated gradients in plant morphology and stature; the characteristic leaf shapes ascribed to these taxa occurred at the extremes in plant size variation but intermediate leaf shapes were found in plants of intermediate size. MOENKEMEYER (1927) treated *B. valida* as a variety of *D. rigidulus* and asserted that there were many transitional forms between it and var. *rigidulus*. Specimens from western North America identified as «*Barbula bescherellei*» have much the same morphological facies as European specimens I have seen that were identified as «*Barbula valida*».



Pl. II. — 1-9 : *Didymodon rigidulus* var. *gracilis*. 1-4 : Leaves. 5-6 : Leaf apices. 7 : Upper marginal cells. 8 : Transverse section. 9 : Peristome. 10 : *D. rigidulus* var. *subulatus*, leaf. 11-13 : *D. rigidulus* var. *icmadophila*. 11 : Leaf. 12 : Leaf apex. 13 : Upper cells. 14 : Transverse section. Magnifications : leaves x 43; leaf apices, upper marginal cells, transverse sections x 100; propagula x 100; capsules and peristomes x 28.

Habitat : soil, gravel, sandstone, limestone, walls, banks, 1300-3360 m elevation.

Distribution : Mexico : Baja California, Chihuahua, Colima, Distrito Federal, Hidalgo, Jalisco, México, Michoacán, Nuevo León, Oaxaca, Puebla, San Luis Potosí, Sonora, Tamaulipas, Tlaxcala, Veracruz.

Range : North and Central America, Europe, the Middle East, and Asia.

— *Didymodon rigidulus* var. *icmadophila* (Schimp. ex C. Muell.) Zander, comb. nov.

Barbula icmadophila Schimp. ex C. Muell., Syn. Musc. 1 : 614. 1849, basio-

nym. — *Tortula icmadophila* (Schimp. ex C. Muell.) Lindb., *Oefv. K. Vet. Ak. Foerh.* 21 : 249. 1864. — *Barbula gracilis* ssp. *icmadophila* (Schimp. ex C. Muell.) Amann, *Fl. Mouss. Suisse* 2 : 105. 1919 — *Barbula gracilis* var. *icmadophila* (Schimp. ex C. Muell.) Moenk., *Laubm. Eur.* : 289. 1927. — *Barbula acuta* ssp. *icmadophila* (Schimp. ex C. Muell.) Podp., *Consp. Musc. Eur.* : 209. 1954. — *Didymodon «icmadophyllus»* (Schimp. ex C. Muell.) Saito, *J. Hattori Bot. Lab.* 39 : 519. 1975, typographic error.

Leaves long-lanceolate, mostly 1.5-3.5 mm long, leaf base sharply dilated, short-ovate, upper margins usually plane, occasionally recurved, usually unistratose, costa excurrent as a long, often thick or flexuose subula, upper laminal cells commonly smooth, basal cells usually quadrate, little differentiated; propagula rarely present; peristome teeth short and straight to long and twisted. **Illustration** : Pl. II, fig. 11-14.

The var. *icmadophila* may rarely have fragile or swollen awns of the excurrent costae, but these are not both caducous early and swollen as in *Didymodon johansenii* (Williams) Crum of New and Old World arctic and northern alpine areas.

Habitat : soil, gravel, rhyolite, cement, brick, limestone, bark, generally at higher elevations than var. *gracilis*, 1750-3600 m elevation.

Distribution : North and Central America, Europe, Asia; recognized in Mexico from the states of Chiapas, Chihuahua, Distrito Federal, Hidalgo, Jalisco, México, Morelos, Oaxaca, Puebla, San Luis Potosí, Tlaxcala, Veracruz, Zacatecas; California.

Range : North and Central America, Europe, Asia.

— *Didymodon rigidulus* var. *subulatus* (Thér. & Bartr. ex Bartr.) Zander, **comb. nov.**

Didymodon mexicanus var. *subulatus* Thér. & Bartr. ex Bartr., *Bryologist* 29 : 1. 1926. **Type** : U.S.A., Arizona, Pima Co., Santa Catalina Mts., Window Trail, Bartram 174 (CU - isotype).

Leaves long-lanceolate, 1.5-2.5 mm long, leaf base long-ovate, upper margins usually plane, upper lamina entirely bistratose, costa excurrent as a subula, upper laminal cells smooth, basal cells short-ovate; propagula apparently absent; peristome very short, rudimentary, of 16 oval teeth with 1-2(-4) articulations. **Illustration** : Pl. II, fig. 10.

In leaf shape and other characters, var. *subulatus* is similar to var. *icmadophila*. Specimens with upper lamina unistratose in large patches represent intergrades. The peristome characters were taken from very few specimens, but, in all, var. *subulatus* appears to be a distinctive geographic variant.

Habitat : soil, rock, 900-2500 m elevation.

Distribution : Mexico : Distrito Federal, Michoacán.

Range : Mexico and U.S.A. : Arizona.

Specimens examined : Mexico : S. loc. , Hahn, 1868 (NY - as *Barbula erythropoda*); Distrito Federal, Bourgeau s. n. (BM, NY - as *Didymodon mexicanus*); Vallée de Mexico, San Juanico, Amable 1332 (FH); Michoacán, Patzcuaro, Pringle 748 (FH, NY - isosyntypes of *Didymodon incrassatolimbatus*). U.S.A. : Arizona, Pima Co., Bartram 174 (CU).

The characters of *Didymodon rigidulus* appear to vary independently of each other except for modalities of correlation at extremes of plant morphological variation that are here recognized as varieties. The bryologist should resist the temptation to distinguish between these varieties by only one character. In eastern U.S.A., var. *rigidulus* usually has bistratose upper leaf margins, has propagula and seems comparatively stenomorphic, but in western North America, these characters are less well correlated and the bryologist is faced with such problems as having to decide whether to identify one specimen as either an unistratose var. *rigidulus* or a propaguliferous var. *gracilis*, or another specimen as either a non-propaguliferous var. *rigidulus* or a bistratose-margined var. *gracilis*. Previous authors have had differing concepts (under names in other combinations) of var. *gracilis* and var. *icmadophila* depending on whether they emphasized relative length of the excurrent costa (DIXON 1924, STEERE 1938, SAITO 1975 among others) or the relative appearance of the median upper laminal cells (NYHOLM 1956, SMITH 1978). Character states of most characters intergrade within the character and correlate only poorly between characters. Although varietal concepts are recognized here because extreme variants are often more common than intergrades and their appearance is rather distinctive, and because the varieties may have some evolutionary and ecological importance, a majority of the type specimens of heterotypic names that clearly belong to *D. rigidulus* s. lat. cannot be assigned — with confidence in repeatability — to varietal synonymies on the basis of any combination of characters. For purposes of determining priority, the name of each of the varieties here regarded as correct is a combination with the earliest legitimate name or epithet (selected from the synonymy of the species s. lat., and chosen first from those available at the varietal level) whose type clearly represents the varietal concept recognized, and all other heterotypic names are assigned to the synonymy of the species sensu lato. Thus, in a field of continuous variation, concepts of extreme or distinctive morphology can be efficiently identified by the same number of type specimens as there are names recognized as correct, of course necessarily inclusive of the type specimen of the typical variety (or other infraspecific level recognized). It is this author's opinion that stability of names is — in this particular case, at least — enhanced by this legal method of circumventing a major deficiency of the I.C.B.N., namely that Principle IV and Articles 25 and 57, taken together, imply that all taxa are discontinuous. This is not the case with the varieties of *D. rigidulus*, yet they are here recognized as (at least potential) biological realities worthy of names. Since duplicability of results is a major criterion of scientific worth, and because designation of synonymy is here

considered a scientific study that should be repeatable by future workers, no heterotypic synonymy is provided here for nondiscontinuous taxa.

3. *DIDYMODON AUSTRALASIAE* (-«II») (HOOK & GREV.) ZANDER EMEND. ZANDER, *Phytologia* 41 : 21. 1978.

- Tortula australasiae* Hook. & Grev., *Edinburgh J. Sci.* 1 : 301. 1824. — *Barbula australasiae* (Hook. & Grev.) Brid., *Bryol. Univ.* 1 : 828. 1827. — *Trichostomopsis australasiae* (Hook. & Grev.) Robinson, *Phytologia* 20 : 187. 1970.
- Barbula graminicolor* C. Muell., *Syn. Musc.* 1 : 611. 1849, syn. nov. **Type** : Chile, Racangua, Bertero, 1828 (BM, PC - isotypes). — *Tortula graminicolor* (C. Muell.) Mont. in Gay, *Hist. Fis. Polit. Chile Bot.* 7 : 156. 1850.
- Didymodon torquescens* Card., *Rev. Bryol.* 36 : 83. 1909, syn. nov. **Type** : Mexico, Michoacán, Bosque de San Pedro, Solorzano, 1908 (PC - holotype). — *Husnotiella torquescens* (Card.) Bartr., *Bryologist* 29 : 45. 1926 — *Asteriscium torquescens* (Card.) Hilp., *Beih. Bot. Centralbl.* 50 (2) : 620. 1933.
- Didymodon craspedophyllus* Card., *Rev. Bryol.* 36 : 81. 1909, syn. nov. **Type** : Mexico, Jalisco, Barranca de Guadalajara, Pringle 15227 (PC - holotype).
- Trichostomopsis crispifolia* Card., *Rev. Bryol.* 36 : 74. 1909. **Type** : Mexico, Hidalgo, Tula, Pringle 15273 (NY - syntype).
- Didymodon diaphanobasis* Card., *Rev. Bryol.* 37 : 125. 1910. **Type** : Mexico, México, Ixtaceluatl, Purpus 3721 (PC - holotype). — *Trichostomopsis diaphanobasis* (Card.) Grout, *Moss Fl. N. Amer.* 1 : 228. 1939.
- Didymodon patentifolius* Thér., *Smithsonian Misc. Coll.* 85(4) : 15. 1931, syn. nov. **Type** : Mexico, D.F., Xoquiapán, Amable 1676 (PC - syntype).
- Trichostomopsis brevifolia* Bartr., *Bryologist* 34 : 61. 1932.
- Trichostomopsis fayae* Grout, *Moss Fl. N. Amer.* 1 : 228. 1939. **Type** : U.S.A., California, Los Angeles Co., MacFadden 8172 (DUKE - holotype).

Plants forming turf and cushions, green to black-green above, brown below. **Stems** often branching, brown, to 0.6(-1.5) cm long, rounded-pentagonal in transverse section, central strand strong, cortical cells not differentiated or with thicker walls, hyalodermis not differentiated or weakly developed or developed in patches to distinct, strongly differentiated; axillary hairs of 3-5 cells, basal cell brown. **Leaves** crowded, when dry spreading-incurved and twisted to incurved-appressed, when wet spreading to spreading-recurved, ovate-triangular to long-elliptical or long-lanceolate, usually 1.0-2.0(-4.0) mm long, adaxial surface broadly channelled across leaf; leaf margins plane to recurved at midleaf to throughout upper half of leaf, entire, bistratose in one to several rows; leaf apex acute, often somewhat cucullate; leaf base scarcely differentiated in shape to ovate and sharply differentiated, basal leaf margins often with one or more

rows of narrow cells bordering median basal cells; **costa** subpercurrent to short-excurrent, adaxial surficial cells quadrate to short-rectangular or elongate, smooth to weakly papillose, abaxial surficial cells elongate or seldom quadrate near apex, smooth to papillose, transverse section of costa elliptical to sub-hemispherical, adaxial surface convex, adaxial epidermis present, abaxial epidermis usually present, lumens oval to semicircular, adaxial stereid band absent, guide cells 3-6 in 1-2 layers, hydroids occasionally present, abaxial stereid band strong to weak or substereid or absent; **upper laminal cells** subquadrate to short-rectangular, 7-12 μm wide, 1-2:1, walls evenly thickened to thickened at the corners, surficially weakly bulging, patterned in longitudinal rows; laminal papillae absent to large, entered over the lumens, solid, simple to bifid, occ. trifid, flattened-rounded, often massive, 1-4 per lumen each side; **basal laminal cells** often sharply differentiated, medially or across leaf base, quadrate to rectangular, often transversely elongate, to 18(-23) μm wide, 2-5:1, walls thin, hyaline, somewhat to distinctly bulging, occasionally resorbed to form transverse slits in the medial portion of the leaf base. **Propagula** occasionally present, red-brown, spherical to elliptical or irregularly shaped, of ca. 2-7 cells, to 85(-100) μm long, borne on rhizoids between lower leaves. **Dioicous**; **perichaetia** terminal, inner leaves long-elliptical, to 2.5(-4.0) mm long, little to half sheathing, prosenchymatous below or to 1/2 of leaf length; **perigonia** terminal on smaller plants, often in series, gemmate, inner leaves entire to serrate. **Sporophyte seta** 1 per perichaetium, 0.7-1.0 mm long, red-brown to yellow, twisted clockwise, occasionally counterclockwise above; **theca** 1.0-1.9 mm long, red-brown to dark yellow-brown, ovoid to elliptical-cylindrical, neck weakly differentiated; exothelial cells rectangular to rhomboidal, 20-25 μm wide, 2-4:1, walls thin; stomates phaneropore, at base of theca; annulus strongly vesiculose, 1-2 rows of cells; **peristome** of 32 teeth, occasionally rudimentary, linear, ca. 600 μm long, with many articulations, yellow, nearly straight to twisted counterclockwise 0.5 times, closely spiculose, basal membrane absent or low, to 60 μm high, branching-spiculose. **Operculum** long-conic, often curved, 0.7-1.2 mm long, cells nearly straight to twisted counterclockwise to one time. **Calyptra** cucullate, smooth, 2.0-2.5 mm long. **Spores** light brown, weakly papillose, 11-15 μm in diameter, possibly occasionally anisoporous in some specimens, 6-9 and 12-15 μm wide. **Laminal color reactions** (after clearing in conc. lactic acid.): Cl (conc. HCl) - green or blue-green + light to medium brown or yellow-brown, or medium orange-brown; K (10% KOH) - green + light to medium yellow-brown, light to dark red-brown, or dark orange-brown; N (conc. HNO_3) - light brown or light to medium red-brown or light orange-brown; SE (H_2SO_4 -ethanol, 2:1) - green + red-orange-brown to medium brown. **Illustration** : Pl. III, fig. 1-8.

In the genus *Didymodon*, hydroids (Begleiter cells) have been seen in the costae of only this species and *D. revolutus*. Hydroids are common in the Potioideae, and the lack of an adaxial stereid band may also indicate a relation to that subfamily. However, the narrow leaves, presence of an abaxial epidermis in the costa, and general appearance, together with the presence of hydroids in both *Barbula* and *Bryocerythrophyllum* spp., support retention of this species in the Barbuloideae. Both varieties recognized below bear tubers. The varieties



PL. III. — 1-4 : *Didymodon australasiae* var. *australasiae*. 1-2 : Leaves. 3 : Leaf apex. 4 : Transverse section. 5-8 : *D. australasiae* var. *umbrosus*. 5 : Leaf. 6 : Leaf apex. 7 : Upper marginal cells. 8 : Transverse section. 9-13 : *D. revolutus*. 9-10 : Leaves. 11 : Leaf apex. 12 : Transverse section. 13 : Propagula. Magnifications : leaves $\times 43$; leaf apices, upper marginal cells, transverse sections $\times 100$; propagula $\times 100$; capsules and peristomes $\times 28$.

are distinctive in extreme form, but intergrade completely in morphology. Their descriptions given below are nondiscontinuous and heterotypic synonyms are not recognized at the varietal level but are given instead for the species *sensu lato*, above.

Habitat : on rock, soil, 137-3750 m elevation.

Distribution : Mexico : Baja California, Chihuahua, Distrito Federal, Jalisco, México, Michoacán, Puebla, San Luis Potosí, Sonora, California.

Range : North, Central and South America, Europe, Canary Islands, South Africa, Australasia.

Key to Varieties of *Didymodon australasiae* (Hook. & Grev.) Zander

(Note : Only salient characters of the idealized taxa are given here.

See descriptions for variation in these and other characters.)

Leaves blackish-green, short-ovate to long-elliptical, apex broadly acute, weakly cucullate, leaf base not sharply differentiated in shape, adaxial costal cells quadrate, upper laminal cells rounded-quadrate. var. *australasiae*

Leaves green to very bright green, long-lanceolate, apex narrowly acute, not cucullate, leaf base sharply differentiated, ovate, adaxial costal cells rectangular, upper laminal cells rectangular. var. *umbrosus* (C. Muell.) Zander

— *Didymodon australasiae* (Hook. & Grev.) Zander var. *australasiae*

Stem hyalodermis absent, occasionally present in patches; plants often blackish-green; costa bulging usually adaxially; leaves short-ovate to long-elliptical, occasionally lanceolate, apex broadly or occasionally narrowly acute, often somewhat cucullate; leaf margins usually recurved, leaf base not or weakly differentiated in shape, not perforated medially; adaxial cells of costa quadrate, occasionally short-rectangular; upper laminal cells rounded-quadrate; upper laminal papillae usually distinct, occasionally very coarse, often absent; basal marginal laminal cells quadrate to rectangular, seldom in distinct rows, medial basal cells quadrate, occasionally longitudinally or transversely short-rectangular, little bulging. **Illustration** : Pl. III, fig. 1-4.

Habitat : rock, soil, 137-3750 m elevation.

Distribution : Mexico : Baja California, Chihuahua, Distrito Federal, Jalisco, México, Michoacán, San Luis Potosí, Sonora, California.

Range : North, Central and South America, Europe, southern Africa, Australasia.

— *Didymodon australasiae* var. *umbrosus* (C. Muell.) Zander, comb. & stat. nov.

Barbula umbrosa C. Muell., *Linnaea* 42 : 340. 1879, basionym. — *Trichostomopsis umbrosa* (C. Muell.) Robinson, *Phytologia* 20 : 185, 1970.

Stem hyalodermis usually present; plants green to very bright green; costa adaxially flattened; leaves long-lanceolate, apex narrowly acute, not cucullate; leaf margins plane, leaf base usually sharply differentiated in shape, ovate, occasionally medially perforated with transverse slits; adaxial cells of costa usually rectangular; upper laminal cells quadrate to rectangular; upper laminal papillae absent, occasionally weakly developed; basal marginal cells narrowly

rectangular in several rows bordering the inflated inner basal cells, occasionally this not clearly evident, medial basal cells short-rectangular, usually somewhat bulging. **Illustration** : Pl. III, fig. 5-8.

Habitat : soil, river margin, 500-2160 m elevation.

Distribution : Mexico : Distrito Federal, Hidalgo, Jalisco, México, Michoacán, Puebla, San Luis Potosí; California.

Range : North and South America, Europe.

4. DIDYMODON REVOLUTUS (CARD.) WILLIAMS, *Bryologist* 16 : 25. 1922.
Husnotiella revoluta Card., *Rev. Bryol.* 36 : 71. 1909, basionym.

Husnotiella palmeri Card., *Rev. Bryol.* 37 : 121. 1910 – *Husnotiella revoluta*
var. *palmeri* (Card.) Thér., *Smiths. Misc. Coll.* 85 (4) : 7. 1931.

Plants bulbiform, gregarious to forming turf, green to black-green above, light brown below. **Stems** seldom branching, brown, to 0.6 cm long, rounded-pentagonal in transverse section, central strand present, often strong or dark brown or both, cortex scarcely differentiated or cortical cells with darker walls, hyalodermis absent or weakly differentiated as a layer of cells larger than the cortical cells; axillary hairs of 3-9 cells, basal one brown. **Leaves** when dry appressed, imbricated, incurved, when wet widely spreading, ovate, 0.4-1.2(-2.0) mm long, adaxial surface broadly channelled across leaf; leaf margins recurved to revolute to near apex, occasionally recurved to just above midleaf, entire, bistratose in small patches or unistratose; leaf apex rounded-obtuse, often strongly cucullate; leaf base scarcely differentiated in shape, margins weakly decurrent; costa ending 1-6 cells below the apex, broad and spurred above midleaf, adaxial surficial cells quadrate, papillose, abaxial surficial cells quadrate to elongate, smooth or papillose; transverse section of costa elliptical, adaxial surface bulging-convex, adaxial stereid band absent, guide cells 2-4 in one layer, hydroids (Begleiter cells) occasionally present, adaxial stereid band present, occasionally substereid; **upper laminal cells** rounded-quadrate to rhomboidal, (6-)8-10 μ m wide, 1:1, walls thick, surficially bulging, lumens rounded-quadrate, arranged in longitudinal rows; papillae often best developed in the upper medial portion of lamina, low, simple or occasionally multiplex or plate-like, usually one per lumen each side, occasionally absent; **basal laminal cells** differentiated medially or across the leaf base, short-rectangular, elongated longitudinally or transversely, 8-11 μ m wide, 1:1-2 or 1-2:1, walls thin to weakly thickened. **Propagula** seldom present, unicellular, spherical to elliptical, red-brown, 16-20 μ m wide, 1:1(-2), borne in large clusters in axils of upper leaves. **Dioicous**; **perichaetia** terminal, inner leaves occasionally smaller, shorter than cauline leaves, weakly sheathing seta, prosenchymatous in lower third; perigonia on smaller gametophores, gemmate. **Sporophyte** seta 1 per perichaetium, 0.35-0.9 mm long, red- to yellow-brown, twisted clockwise, counterclockwise above; **theca** 0.7-1.5 mm long, red-brown to dark brown, smooth when dry, elliptical to short-

cylindrical, neck weakly differentiated; exothecial cells rectangular, 16-22 μm wide, 2-3:1, walls weakly thickened; stomates present at base of theca, **phaneropore**; annulus of 1-3 rows of highly vesiculose cells, deciduous in pieces; **peristome** absent to rudimentary, teeth irregularly ligulate, to 65 μm long, to 4 articulations, straight, papillose, yellow to red-brown; **operculum** conic, rather oblique, 0.3-0.4 mm long, cells not twisted. **Calyptra** cucullate, smooth, 1.7-2.0 mm long. **Spores** yellow to brown, smooth to lightly papillose, 9-11 μm in diameter. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green + medium to dark yellow-brown; K (10% KOH) - light brown to medium red-orange-brown; N (conc. HNO_3) - medium brown to red; SE (conc. H_2SO_4 -ethanol, 2:1) - dark green + medium orange-brown or medium red-brown. **Illustration** : Pl. III, fig. 9-13.

I concur with WILLIAMS' (1913) opinion that *Husnotiella revoluta* belongs with *Didymodon*. *Husnotiella torquescens* is a synonym of *D. australasiae*. ROBINSON (1970) noted that some specimens of *D. revolutus* (as *Husnotiella revoluta*) resemble *D. australasiae* (as *Trichostomopsis australasiae*). There is indeed a close relationship between the two taxa as at least some specimens of each share the following character states : leaves occasionally with plane margins, apex often cucullate, marginal laminal cells often bistratose, adaxial costal surface bulging and hydroids evident in the costal transverse section. *Didymodon revolutus* differs from *D. australasiae*, however, in these respects : rudimentary or absent peristome, rounded-obtuse leaf apex, often revolute laminal margins, subpercurrent costa with spurs, and one layer of guide cells instead of two. *Bryoerythrophyllum calcareum* (Thér.) Zander is similar to *D. revolutus* in gametophytic characters but may be distinguished by the former's crowded, hollow, multiplex papillae with several salients per lumen each side.

Habitat : soil, rock, walls, to 2280 m elevation.

Distribution : Mexico : Baja California, Distrito Federal, Durango, Hidalgo, Jalisco, México, Michoacán, Morelos, Puebla, San Luis Potosí, Tlaxcala, Zacatecas; California.

Range : southwestern U.S.A. : California, Arizona, Texas, Oklahoma; Mexico; Guatemala; Andes of South America.

5. DIDYMODON FALLAX (HEDW.) ZANDER, *Phytologia* 41 : 28. 1978.
Barbula fallax Hedw., Spec. Musc. : 120. 1801.

Barbula ferruginea Schimp. ex Besch., *Mém. Soc. Nat. Sci. Nat. Cherb.* 16 : 181. 1872. **Type** : Mexico, San Cristobal, Mueller s. n. (PC - holotype; BM, NY - isotypes). - *Triquetrella ferruginea* (Schimp. ex Besch.) Thér., *Smiths. Misc. Coll.* 85 (4) : 9. 1931.

Plants in turf or loose cushions, green to reddish-brown above, brown to reddish-brown below. **Stems** irregularly branching, yellow- to red-brown or

dark brown, to 2.0 cm long, rounded pentagonal in transverse section, central strand present, cortex differentiated as 2-3 layers of stereid cells, hyalodermis absent; axillary hairs of 4-5 cells, basal one brown; stem often flattened. **Leaves** when dry appressed to weakly spreading, when wet spreading to strongly reflexed-recurved, ovate-triangular to lanceolate, 1.2-2.0 mm long, keeled; leaf margins nearly plane to recurved to midleaf, entire; leaf apex acute; leaf base scarcely differentiated to ovate, basal margins narrowly to broadly decurrent, occasionally somewhat auriculate; costa short-excurrent in an often papillose mucro, adaxial surficial cells short-rectangular to elongate, smooth, abaxial surficial cells quadrate to near base, often papillose, transverse section of costa semicircular, adaxial surface mostly concave, adaxial epidermis absent, abaxial epidermis present, lumens of cells oval to hexagonal, adaxial stereid band absent or of few cells, guide cells 2-4 in one layer, abaxial stereid band seldom strong, often reduced or absent; **upper laminal cells** subcircular to rhomboidal or pentagonal, (5-)-8-11 μm wide, 1:1 or 1.5:1, occasionally transversely elongate, walls thickened at the corners, surficially bulging, lumens oval to triangular or diamond-shaped, arranged on longitudinal rows; laminal papillae absent or simple, solid, 1-3 centered over lumens on each side, occasionally bi- to trifid; **basal laminal cells** not or weakly differentiated, quadrate or short-rectangular. **Dioicous**; **perichaetia** terminal, inner leaves enlarged, to 3.0 mm long, leaf base rectangular, sheathing seta, prosenchymatous in lower 2/3; perigonia terminal, occasionally in series, gemmate, inner leaves ovate. **Sporophyte seta** 1 per perichaetium, 0.6-1.2 cm long, yellow-brown, twisted clockwise; **theca** 1.2-1.5 mm long, brown, smooth when dry, cylindrical to elliptical, neck weakly differentiated; exothelial cells rectangular, 14-27 μm wide, 2-3:1, walls thin; stomates present at base of theca, phaneropore; annulus weakly differentiated, of 2-3 rows of vesiculose cells; **peristome** of 16 teeth cleft to near base, linear, 275-1100 μm long, straight to twisted counterclockwise once, yellow to yellow-orange, densely papillose to weakly spiculose, basal membrane low to rather high, 25-70 μm high, papillose; **operculum** long-conic, 1.2-1.3 mm long, cells in straight rows or twisted to one time. **Calyptra** not seen. **Spores** light yellow-brown, weakly papillose, 7-9 μm in diameter. $n = 9, 10, 11, 13, 13 + 1$. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green + medium yellow-brown to light orange; K (10% KOH) - light to dark red-brown, occasionally medium brown or deep red-orange-brown; N (conc. HNO_3) - light brown to red-brown; SE (H_2SO_4 -ethanol, 2:1) - blue-green + light to dark red-brown, occasionally orange-brown.

Distinctions between true *Triquetrella*, known only from California, and *D. fallax* are discussed by ZANDER (1980). All collections of *D. fallax* seen were aff. var. *reflexus* but probably material aff. var. *fallax* will eventually turn up in Mexico. I agree with FLOWERS' (1973) observations that character states typical of the varieties as recognized here are not constant. The varieties are characteristic only in extreme form - for this reason the synonym *Triquetrella ferruginea* is placed with *D. fallax* sensu lato, although the type of the former is aff. var. *reflexus*.

- *Didymodon fallax* var. *reflexus* (Brid.) Zander, *Bryologist* 83 : 230. 1980. *Tortula reflexa* Brid., *Musc. Recent. Suppl.* 1 : 255. 1806. — *Barbula reflexa* (Brid.) Brid., *Mant. Musc.* : 93. 1819. — *Barbula fallax* var. *reflexa* (Brid.) Brid., *Bryol. Univ.* 1 : 558. 1826.

Leaves reddish-brown, strongly recurved, apex broadly acute, laminal cell walls strongly thickened, laminal papillae usually present, often high. Plate IV, fig. 1-5.

Habitat : rock, limestone, bark, 2200-2800 m elevation.

Distribution : Mexico : Distrito Federal, Nuevo León, Oaxaca, Puebla, Veracruz.

Range : eastern and central North America, Europe, North Africa, Asia.

6. DIDYMODON MICHIGANENSIS (STEERE) SAITO, J. Hattori Bot. Lab. 39 : 516. 1975.

Barbula michiganensis Steere in Grout, *Moss Fl. N. Amer.* 1 : 180. 1938.

Type : U.S.A., Michigan, Alger Co., Pictured Rocks, Nichols & Steere, 1935 (DUKE - isotype).

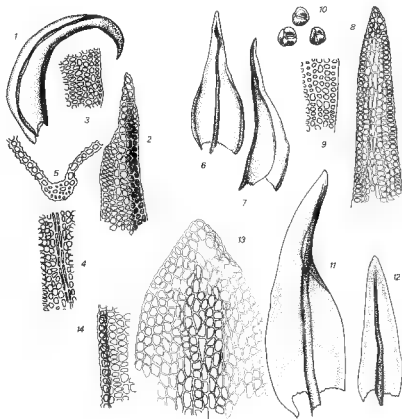
Plants in loose turf, green or glossy green above, brown below. **Stems** seldom branching, brown, to 2(-6) cm long, rounded-pentagonal in transverse section, central strand present, cortex of 2-3 layers of stereid cells, hyalodermis absent; axillary hairs of 4 cells, basal one brown; stem somewhat flattened. **Leaves** when dry catenulate-incurved, when wet spreading ca. 45°, lanceolate to ovate-lanceolate, 0.9-1.1, keeled in upper third; leaf margins narrowly to broadly recurved in lower 1/2-2/3, entire; leaf apex acute to acuminate; leaf base broadly ovate, basal margins short and broadly decurrent, often weakly but distinctly auricled; **costa** percurrent to very shortly excurrent, adaxial surficial cells rectangular, smooth, abaxial surficial cells short-rectangular or quadrate, smooth, transverse section of costa semicircular, adaxial surface concave, adaxial epidermis lacking, abaxial epidermis present, cells with oval lumens, adaxial stereid band lacking (apparently represented by 1-2 layers of substereid or parenchymatous cells), guide cells 2 in one layer, abaxial stereid band absent or weak; **upper laminal cells** rhomboidal to rounded pentagonal, 7-9(-12) μm wide, 1-2:1, walls thickened at the corners, often very thick, lumens angular to oval, in very distinctive longitudinal rows; laminal papillae absent to low, simple; **basal laminal cells** not to weakly differentiated, quadrate to rectangular, 9-13 μm wide, 1-2:1, walls thick. **Propagula** usually present, spherical to elliptical, red to orange, 13-25 μm wide, 1-2:1, of 1-4 cells, borne in masses in the leaf axils. **Sporophyte** not seen. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green + light to deep yellow or yellow-orange; K (10% KOH) - light yellow-orange-brown to deep orange; N (conc. HNO_3) - light yellow-brown to medium orange; SE (conc. H_2SO_4 -ethanol, 2:1) - green + medium red-brown. **Illustration** : Pl. IV, fig. 6-10

Didymodon michiganensis is similar to *D. fallax* in morphology and may be mistaken for the latter when propagula are absent; however, the following characters are diagnostic : leaves not keeled or recurved when moist, strongly catenulate when dry, lower margins strongly recurved, and upper laminal cells in distinct longitudinal rows and very thick-walled.

Habitat : cliffs, stone walls, boulder, to 2440 m elevation.

Distribution : Mexico : Chihuahua.

Range : Canada : Northwest Territories; U.S.A. : Michigan; Mexico; India : Assam; Japan.



PL. IV. - 1-5 : *Didymodon fallax* var. *reflexus*. 1 : Leaf. 2 : Leaf apex, lateral view. 3 : Upper marginal cells. 4 : Elongate adaxial costal cells. 5 : Transverse section. 6-10 : *D. michiganensis*. 6-7 : Leaves. 8 : Leaf apex. 9 : Upper marginal cells. 10 : Propagula. 11-14 : *D. tophaceus*. 11-12 : Leaves. 13 : Leaf apex. 14 : Upper marginal cells. Magnifications : leaves x 43; leaf apices, upper marginal cells, transverse sections x 100; propagula x 100; capsules and peristomes x 28.

7. **DIDYMODON TOPHACEUS (BRID.) LISA**, Elenco Muschi Torino : 31.1837. *Trichostomum tophaceum* Brid., Mant. Musc. : 84.1819. — *Barbula tophacea* (Brid.) Mitt., J. Linn. Soc. Bot. Suppl. 1 : 34.1859.

Dactylhymenium pringlei Card., Rev. Bryol. 36 : 72. 1909. **Type** : Mexico, Chihuahua, Chihuahua, Pringle 4 (PC - lectotype; BM - isotype). — *Barbula pringlei* (Card.) Hilp., Beih. Bot. Centralbl. 50 (2) : 645. 1933, hom. illeg. non Card. 1909. — *Husnotiella pringlei* (Card.) Grout, Moss Fl. N. Amer. 1 : 219. 1939.

Barbula abbonii Thér., Smiths. Misc. Coll. 85 (4) : 20. 1931. **Type** : Mexico, Nuevo León, Monterrey, Abbon 10970 (PC - lectotype; BM, FH - isotypes).

Plants in turf or cushions, green to olive-green above, tan below, costa often dark brown. **Stems** irregularly branching, brown, to 1.5 cm long, transverse section rounded pentagonal, central strand present, cortex of 2-3 layers of darker, smaller cells, hyalodermis absent; axillary hairs of 3-5 cells, basal one brown. **Leaves** when dry spreading to 45°, occasionally appressed or nearly so, when wet spreading, ligulate to ovate-lanceolate, 1.0-1.9 mm long, adaxial surface broadly channelled to keeled; leaf margins weakly recurved in lower 3/4, entire or occasionally crenulate apically, occasionally bistratose in patches; leaf apex broadly acute to obtuse or rounded; leaf base ovate, basal margins usually broadly decurrent, rarely low, small lamellae present medially abaxially; **costa** percurrent or ending up to 6 cells below apex, occasionally short-excurrent, adaxial surficial cells rectangular, smooth, abaxial surficial cells quadrate or rectangular, usually smooth, transverse section of costa semicircular, adaxial surface concave to convex, adaxial epidermis absent, abaxial epidermis present, cell lumens oval, adaxial stereid band absent or represented by substereid cells, guide cells 2-4 in one layer, abaxial stereid band weak or absent; **upper laminal cells** oval to rhomboidal or triangular, (7-)9-12(-14) μ m wide, 2-1:1 or 1:1-2, often longitudinally and occasionally transversely elongate, surficially bulging, lumens angular to dumbbell-shaped, arranged in longitudinal rows, heterogeneous in size and shape; laminal papillae low, broad, simple, 1-2 salients per lumen each side, sometimes apparently absent; **basal laminal cells** little differentiated, 10-12 μ m wide, 2-1:1, walls irregularly thickened. **Dioicous**; **perichaetia** terminal, inner leaves ovate-lanceolate, to 1.5 mm long, somewhat sheathing the seta, prosenchymatous to near apex; perigonia terminal, gemmate, inner leaves ovate. **Sporophyte seta** 1 per perichaetium, 0.7-0.9 mm long, red-brown, twisted clockwise; **theca** 0.6-1.3 mm long, red-brown, smooth when dry, ovate to short-cylindrical, neck weakly differentiated, mouth occasionally oblique; exothelial cells rhomboidal to rectangular, 15-25 μ m wide, 1-3:1, walls evenly thickened; stomates present on neck, phaneropore; annulus of 2-3 rows of weakly vesiculose cells; **peristome** absent, rudimentary or short, of 16 teeth cleft to near base, occasionally perforated below, ligulate, to 220 μ m long, straight, 1-5 articulations, light yellow, spiculose to papillose, basal membrane absent; **operculum** long-conic, 1.0-1.2 mm long, cells in straight rows. **Calyptra** cucul-

late, smooth, ca. 2.5 mm long. **Spores** brown, weakly papillose, 12-14(-20) μ m in diameter. \blacksquare = 12, 13. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green + medium yellow, yellow-brown or yellow-orange-brown; K (10% KOH) - light to dark red-orange-brown, occasionally light to deep red-orange or orange, seldom light red-brown or deep yellow-orange; N (conc. HNO₃) - tan to light orange-brown; SE (conc. H₂SO₄ - ethanol, 2:1) - blue-green + deep red or yellow-orange-brown or red-orange-brown. **Illustration** : Pl. IV, fig. 11-14.

The broad decurrencies of the basal margins of the leaves of *D. tophaceus* are usually best developed in large plants - small-sized specimens may lack this characteristic of the species that some authors consider diagnostic (discussion by ZANDER 1978a). The type of the synonym *Barbula abbonii* has small lamellae on the medial portion of the leaf bases of many leaves, abaxially; this has been seen in no other specimen examined. «*Didymodon luridus*» has morphology similar to *D. tophaceus*, but is here treated as a variety of *D. vinealis*, to which it keys in the key to species (above). *Didymodon fallax* intergrades somewhat with *D. tophaceus* gametophytically in eastern U.S.A., but intermediate specimens have not been seen in Mexico or California.

Habitat : soil, rock, calcareous rock, wet areas, riversides, springs, 1100-2200 m elevation.

Distribution : Mexico : Baja California, Baja California Sur, Chiapas, Chihuahua, Coahuila, Durango, Hidalgo, Jalisco, México, Morelos, Nuevo León, Puebla, San Luis Potosí, Sonora; California.

Range : North, Central and South America, Europe, Africa, and Asia.

8. DIDYMODON VINEALIS (BRID.) ZANDER EMEND. ZANDER, *Phytologia* 41 : 25. 1978.

Barbula vinealis Brid., Bryol. Univ. 1 : 830. 1827. - *Barbula fallax* var. *vinealis* (Brid.) Hueb., Musc. Germ. : 327. 1833. - *Tortula fallax* var. *vinealis* (Brid.) De Not., Mem. R. Acc. Sc. Torino 40 : 319. 1838. - *Tortula vinealis* (Brid.) Spruce, London J. Bot. 4 : 194. 1845. - *Barbula cylindrica* var. *vinealis* (Brid.) Lindb., Musci Scand. : 22. 1879, nom. illeg. prior. ut spec. - *Barbula cylindrica* ssp. *vinealis* (Brid.) Dix., Stud. Handb. Brit. Moss. : 197. 1896.

Barbula rectifolia Tayl., London J. Bot. 5 : 49. 1849, syn. nov. **Type** : Ecuador, Pichincha, Jameson, 1827 (NY - isotype). - *Tortula rectifolia* (Tayl.) Mitt., J. Linn. Soc. Bot. 12 : 158. 1869.

Tortula olivacea Besch. ex Mitt., J. Linn. Soc. Bot. 12 : 631. 1869, syn. nov. **Type** : Mexico, D.F., prope Santa Fe, Bourgeau 1331 (BM, NY, PC - isotypes). - *Barbula olivacea* (Mitt.) Besch., Mém. Soc. Sc. Nat. Cherbourg 16 : 181. 1872.

Barbula bourgaeana Besch., Mém. Soc. Sc. Nat. Cherbourg 16 : 179. 1872, syn. nov. **Type** : Mexico, D.F., in monte Zacualco prope Guadalupe,

Bourgeau 1321 (BM, NY, PC - isotypes).

Barbula lozanoii Card., *Rev. Bryol.* 36 : 85. 1909, syn. nov. **Type** : Mexico : Puebla, Honey Station, Pringle 10653 (PC - lectotype; TENN - isotype); Nuevo León, Monterey, Pringle 10459 (BM, FH, PC - isosyntypes); Hidalgo, Tula, Pringle 15216 (FH, PC - isosyntypes).

Barbula salazarensis Thér., *Rev. Bryol. Lichénol.* 5 (1932) : 96. 1933, syn. nov. **Type** : Mexico, D.F., Salazar, St. Pierre 1919 (PC - holotype).

Plants forming turf or cushions, green to dark green, occasionally reddish-brown above, light brown below. **Stems** occasionally branching, red-brown, to 2.0 cm long, rounded pentagonal, central strand present, often strong or brown or hollow, cortex little differentiated or of 1-2 layers of smaller, thick-walled cells, hyalodermis absent, axillary hairs of 4-5 cells, basal one brown; stem occasionally flattened. **Leaves** when dry appressed-twisted to incurved-twisted or spreading-flexuose, when wet spreading to spreading-recurved, short- to long-lanceolate or long-oval, 2.5-3.5(-4.0) mm long, adaxial surface broadly grooved along the costa, narrowly so near apex; leaf margins recurved at leaf base to recurved to near apex, entire, unistratose to bistratose in patches or evenly; leaf apex obtuse to narrowly acute, often apiculate by a smooth, conical cell; leaf base scarcely differentiated to oblong, basal margins short and broadly decurrent; costa percurrent to short-excurrent, evenly thick to apex, abaxially somewhat bulging, ad- and abaxial surficial cells quadrate to short-rectangular, smooth to papillose, transverse section of costa semicircular to elliptical, adaxial surface weakly convex to flat, adaxial stereid band absent, usually represented by thin-walled to substereid cells, guide cells 4(-6) in 1(-2) layers, abaxial stereid band distinct, strong, ad- and abaxial epidermal layers differentiated, lumens of abaxial cells quadrate to semicircular; **upper laminar cells** quadrate, 7-9(-14) μm wide, 1:1, walls thin to evenly thickened, occasionally porose, weakly surficially bulging, arranged in longitudinal rows, often in distinct patch-work, relatively homogeneous in size and shape; laminar papillae seldom absent, weakly developed to strong, simple to bifid, occasionally appearing multiplex, solid or hollow, centered over the lumens, 1-5 per lumen each side; **basal laminar cells** scarcely differentiated to weakly differentiated medially, quadrate to short-rectangular, to 10-11 μm wide, 1-2:1, walls thin to evenly thickened. **Propagula** rare, spherical to elliptical, brown, 21-30(-55) μm long, of 1-2(-8) cells, born in clusters on crowded branching stalks in leaf axils. **Dioicous**; **perichaetia** terminal, inner leaves oblong-lanceolate, little differentiated, loosely sheathing the seta, prosenchymatous in lower half; perigonia terminal, often in series, gemmate, inner leaves ovate. **Sporophyte seta** 1 per perichaetium, 0.8-1.0 mm long, red-brown to yellow, weakly twisted clockwise; **theca** 1.5-2.5 mm long, light red-brown to brown, nearly smooth when dry, cylindrical, neck absent; exothelial cells rectangular, 16-20(-25) μm wide, 4-6:1, walls thin to evenly thickened; stomates at base of urn, phaneropore; annulus of 1-2 rows of vesiculose cells; **peristome** of 32 linear, yellow to orange-red, densely spiculate teeth, 185-1300 μm long, straight to twisted 0.25-0.50 times, basal membrane low, distinct, 50-70 μm high, spiculate; **operculum** long-conic, 1.1-1.4 mm long, cells weakly

twisted counterclockwise. **Calyptra** cucullate, smooth, 2.8 mm long. **Spores** yellow-brown, smooth, 9-12 μ m wide. ■ = 10, 12, 13, 13 + 1m, 14. **Laminal color reactions** (after clearing in conc. lactic acid) : Cl (conc. HCl) - green or yellow-green + light to medium yellow-brown, occasionally light-brown, orange, or yellow-orange; K (10% KOH) - light to dark red to red-brown, often medium to deep red-orange-brown, occasionally medium orange-brown; N (conc. HNO₃) - light brown to red-brown, light yellow to orange-brown; SE (conc. H₂SO₄-ethanol, 2:1) - dark green + medium red-brown to dark red. **Illustration** : Pl. V, fig. 1-12.

A majority of specimens of *Didymodon vinealis* have a bright to dark red color with KOH. Although this is not a constant feature and is occasionally duplicated in other species of *Didymodon*, color in KOH may be used as an additional character when identifying small specimens of the genus, which can appear rather characterless. Propagula are rare in *D. vinealis*. They are present in var. *vinealis* (Mexico, Michoacán, Huerta, 1969 - TENN, as *D. godmanianus*) and var. *luridus* (U.S.A., Arizona, Mariposa Co., Zander 4366 - BUF). Like *D. rigidulus*, *D. vinealis* is treated here as ■ complex of morphologically intergrading variants that are distinctive in extreme appearance and some of which have characteristic geographic ranges. Likewise, heterotypic synonyms are not assigned to the varieties of *D. vinealis* but are placed with the species sensu lato. Good summations of some expressions of variation are given by STEERE (1938) and FLOWERS (1973), both of whom seem to recognize an intergradation of short- and long-leaved plants.

Habitat : soil, rock, acidic to calcareous situations, moist to dry, sealevel to 2130 m elevation.

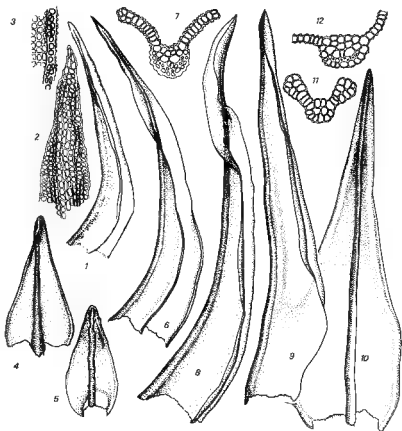
Distribution : Mexico : Baja California, Coahuila, Distrito Federal, Hidalgo, México, Nuevo León, Puebla; California.

Range : western North America, Central America, South America, Europe, Asia and Africa.

Key to Varieties of *Didymodon vinealis* in Mexico and California

1. Leaves short-ovate to ovate-triangular, usually short, to 1.5 mm long. 2.
1. Leaves long-ovate to long-lanceolate, often long, to 4.0 mm long 3.
2. Upper laminal cells thin-walled, papillose, apex blunt and often apiculate by ■ conical cell . . *D. vinealis* var. *brachyphyllus* (Sull. in Whipple) Zander
2. Upper laminal cells with evenly thickened walls, smooth, apex acute to rounded. *D. vinealis* var. *luridus* Hornsch.
3. Upper laminal cells large, 10-13 μ m wide
- *D. vinealis* var. *rubiginosus* (C. Muell.) Zander
3. Upper laminal cells small, 7-10 μ m wide. 4.
4. Leaves long-ovate to broadly lanceolate, apex blunt to broadly acute, upper marginal cells evenly bistratose or occasionally bistratose in patches; laminal color reaction K deep yellow- or orange-brown, seldom red-brown *D. vinealis* var. *nicholsonii* (Culm.) Zander

4. Leaves narrowly lanceolate, apex narrowly acute, upper marginal cells unistratose to bistratose in patches; laminal color reaction K deep red to red-brown 5.
5. Leaves long, often to 4.0 mm, twisted or flexuose above, margins recurved along leaf base *D. vinealis* var. *flaccidus* (B.S.G.) Zander
5. Leaves shorter, to 3.0 mm, not or little twisted, margins usually recurved to above midleaf *D. vinealis* (Brid.) Zander var. *vinealis*



Pl. V. — 1-3 : *Didymodon vinealis* var. *vinealis*. 1 : Leaf 2 : Leaf apex. 3 : Upper marginal cells. 4 : *D. vinealis* var. *brachyphyllus*, leaf. 5 : *D. vinealis* var. *luridus*, leaf. 6-7 : *D. vinealis* var. *rubiginosus*. 6 : Leaf. 7 : Transverse section. 8 : *D. vinealis* var. *flaccidus*, leaf. 9-12 : *D. vinealis* var. *nicholsonii*. 9-10 : Leaves. 11 : Transverse section near apex. 12 : Transverse section near midleaf. Magnifications : leaves x 43; leaf apices, upper marginal cells, transverse sections x 100; propagula x 100; capsules and peristomes x 28.

— *Didymodon vinealis* (Brid.) Zander var. *vinealis*

Leaves lanceolate, to 3.0 mm long; leaf apex acute, narrowly grooved to terete; leaf margins usually recurved to above midleaf; upper laminal cells 7-10 μ m wide, nearly smooth to highly papillose, often thick-walled, upper marginal cells unistratose or bistratose in patches. $n = 14$. Illustration : Pl. V, fig. 1-3.

This taxon represents central or intermediate morphology (from which the other varieties may be conceptually derived by elaboration or reduction with minimum morphological change). No such morphologically central taxon is recognized here for the other major complex, *D. rigidulus* s. lat.; however, if sure characters can be found to distinguish a *D. rigidulus*-related variant from *D. vinealis* var. *luridus* as conceived here, then *D. rigidulus* var. *gracilis* would represent that central morphology within *D. rigidulus* s. lat.

Habitat : soil, rock, sea level to 2130 m elevation.

Distribution : Mexico : Baja California, Coahuila, Distrito Federal, Hidalgo, México, Nuevo León, Puebla; California.

Range : western North America, Central and South America, Europe, Asia, Africa.

— *Didymodon vinealis* var. *brachyphyllus* (Sull. in Whipple.) Zander, comb. nov. *Barbula brachyphylla* Sull. in Whipple., *Rep. Pacif. Railr. Surv. Bot.* 4 : 186. 1856, basionym. — *Didymodon brachyphyllus* (Sull. in Whipple.) Zander, *Phytologia* 41 : 24. 1978.

Leaves ovate to ovate-triangular, to 1.5 mm long; leaf apex broadly acute to obtuse, usually apiculate, often rather cucullate; leaf margins usually recurved to near apex; upper laminal cells 7-10 μ m wide, weakly papillose, thin-walled, upper marginal laminal cells unistratose to occasionally bistratose in patches. $n = 10, 12$. Illustration : Pl. V, fig. 4.

This variety is closely related to, or may be the same as *D. reedii* Robins. of eastern U.S.A. and *D. tectorum* (C. Muell.) Saito of Asia.

Habitat : soil, rock, 135-1600 m elevation.

Distribution : Mexico : Distrito Federal; California.

Range : Mexico; western U.S.A. : Washington, Oregon, California, Montana, Utah, Colorado, Arizona (cf. LAWTON 1971); Canada : British Columbia.

Specimens examined : Mexico : D.F., near Santa Fé, Bourgeau 1331 (BM, NY). U.S.A. : California : s. loc., Bigelow s. n., Sull. & Lesq., Musc. Bor. Amer. 100c (CU); San Diego Co., Anza Borrego Desert State Park, Stark 472-D (PAC); Riverside Co., Joshua Tree National Monument, Norris 50513 (HSC); Tehama Co., near Manton, bluff over Battle Creek, Norris 21332 (HSC). Utah : Millard Co., Boardman U.S. Navy Bombing and Gunnery Range, just S of Boardman, Christy 1398-2 (herb. J.A. Christy; BUF). Canada : British Columbia : S side of Thompson R., between Cache Creek and Savonah, Wallachin, Roadside, McIntosh & Kruckeberg 5250 (UBC).

- *Didymodon vinealis* var. *luridus* (Hornsch. in Spreng.) Zander, comb. nov. *Didymodon luridus* Hornsch. in Spreng., Syst. Veg. 4 (1) : 173. 1827, basionym. — *Barbula lurida* (Hornsch. in Spreng.) Lindb., Musci Scand. : 22. 1879. — *Didymodon trifarius* var. *luridus* (Hornsch. in Spreng.) Mont., Arch. Bot. 1 : 139. 1833. — *Trichostomum luridum* (Hornsch. in Spreng.) Spruce, Ann. Mag. Nat. Hist. Ser. 2, 3 : 379. 1849.

Leaves short-lanceolate to ovate-triangular; leaf apex broadly acute to rounded-obtuse; leaf margins usually recurved to above midleaf, often strongly recurved above; upper laminal cells 7-10 μ m wide, smooth to weakly papillose, walls usually irregularly thickened, lumens often rounded or triangular to pentagonal; upper marginal cells unistratose. **Illustration** : Pl. V, fig. 5.

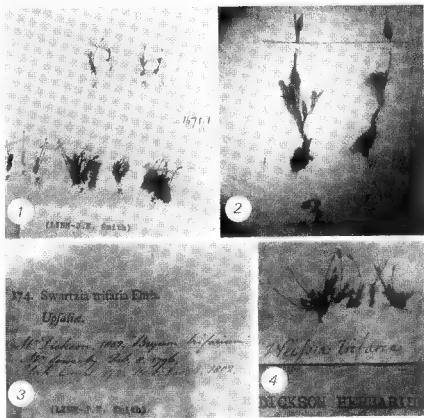
Plants with similar leaf morphology but elongate adaxial surficial costal cells are *D. tophaceus*. The leaf apex of var. *luridus* usually has an adaxial costal groove, the costa is about equally wide to the apex, and at least European specimens are mostly bright red in color with KOH — all characteristics fairly constant in the *D. vinealis* group. It may well be that variants of *D. rigidulus* — which is occasionally red in KOH — with short, blunt leaves may be here included in var. *luridus*, but, to date, no sure way of distinguishing these has been found.

CRUM et al. (1973) and ZANDER (1978a) did not recognize *D. luridus* in North America north of Mexico, referring most collections identified as this to *D. tophaceus* (with acute leaf apices). After seeing more collections and using laminal color reactions to some extent, I present here a concept of the taxon somewhat different and at a different taxonomic level than that of FLOWERS (1973), STEERE (1938) and other American authors who have treated it under the name *D. trifarius* (Hedw.) Roehl., they indicating that it has a close relationship with *D. tophaceus*, which it has not. Material from U.S.A. : Washington, California, Arizona; Mexico and Guatemala matches that from Europe in BUF and keys to *D. vinealis* in the above key to species of *Didymodon*.

Didymodon luridus is often placed in the synonymy of *D. trifarius*. *Didymodon trifarius* (Hedw.) Roehl. is based on *Cynodontium trifarium* Hedw. HEDWIG (1801) characterized the genus *Cynodontium* as «Flos terminalis hermaphroditus (i.e. monoicous)», including what are now *Didymodon trifarius*, *Distichium capillaceum* (Hedw.) B.S.G., *D. inclinatum* (Hedw.) B.S.G. and *Bryum uliginosum* (Brid.) B.S.G. (fide VAN DER WIJK et al. 1959-1969). The last two taxa are autoicous and *D. capillaceum* is paroicous, but species of *Didymodon* are always dioicous. HEDWIG included references to the following elements : specimens «Upsaliae legit Ehrhart» and «in Anglia, Scotia Dicksonus,» and a reference «Hedw. St. Cr. p. 76 t. 28. Swartzia trifaria. Brid. Muscol. II p. 120» to his (HEDWIG 1789) description and illustration of «Swartzia trifaria». The BRIDEL reference (BRIDEL 1798) cites other authors but these lead back to HEDWIG (KOPONEN 1979).

KOPONEN (1979) quite rightly noted that my assumption (ZANDER 1978c) was incorrect that the specimen labeled «Swartzia trifaria» in Hed-

wig's herbarium at G was the holotype of the species, because other elements were mentioned in the protologue. He indicated that it may be possible to choose a lectotype for *Didymodon trifarius* in such a way as to preserve current usage. The simple specimen labeled «*Swartzia trifaria*» in G-Hedwig proved to be taxonomically *Saelania glaucescens* (Hedw.) Broth. (ZANDER 1978c). In an effort to track down additional elements, I was permitted to examine the original herbarium of J. Dickson at BM. The only specimens possibly a syntype was labeled (but not in Dickson's handwriting — see Pl. VII, fig. 4) «*Weisia trifaria*». This specimen was taxonomically *D. tophaceus*. I was also allowed to examine specimens (Pl. VI, fig. 1-3) at the J.E. Smith herbarium (LINN), which

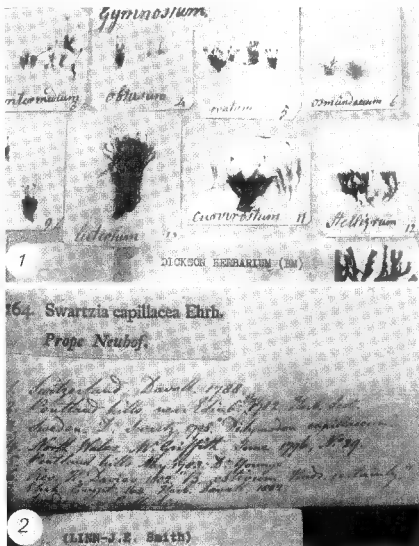


Pl. VI. — 1-3 : «*Swartzia trifaria*» collections — sheet 1671.1 — in herbarium of J.E. Smith at LINN. 1 : The specimens, of which numbers 1 and 3 may be isosyntypes of *Cynodontium trifarium* Hedw. 2 : Close up of the Ehrhart 174 plants. 3 : Label for sheet 1671.1. 4 : Possible isosyntype of *Cynodontium trifarium* Hedw. in herbarium of J. Dickson at BM.

included a specimen labeled «Mr. Dickson. 1802. «*Bryum trifarium*»» and another labeled both «Ehrh. Crypt. 174. Herb. Davall. 1802» and «174. *Swartzia trifaria* Ehrh. *Upsaliae*». These may or may not be syntypes as «1802» may refer to date of collection or date of communication (but probably the latter). Regulations at LINN do not allow dissection or examination of specimens with a high-power microscope; however, the Dickson specimen was similar to that in his herbarium, and the Ehrhart specimen matched that in G. With the dissecting microscope available at LINN, the latter looked quite like specimens at BUF of *Saelania glaucescens* with rather short capsules. The illustrations of *S. glaucescens* and «*Swartzia trifaria*» of HEDWIG (1789, 1792) are very similar (contrary to the view of KOPONEN 1979), except for capsule shape (anyway variable in *S. glaucescens*) and flexion of peristome teeth (straight when dry but variably incurved at first when wet). The exsiccatum of Ehrhart 174 in Ehrhart's original herbarium at GOET is not available by loan for study. My discussion (ZANDER 1978c) of past use of the name *D. trifarius* by early authors after HEDWIG (1801) shows that many regarded *D. trifarius* and *D. luridus* as different. Some thought the former name was a nomen ambiguum. Others ignored it. LINDBERG (1864) apparently examined the Ehrhart syntype and placed it in the synonymy of *Trichostomum viridulum* Bruch in F. Muell. (as *T. crispulum* var. *angustifolium* B.S.G.) (perhaps a mixture is involved?).

Inasmuch as major isosyntype specimens (1) are unavailable for study, or labeled in an ambiguous fashion, or apparently mixed or scattered, (2) their identification is hampered by overly restrictive curatorial regulations, (3) the protologue of the first valid publication (1801) surely requires a lectotype with a monoicous condition (preferably synoicous — *Saelania glaucescens* is autoicous, but HEDWIG 1789 may have made a mistake in this although this is most unlikely), and (4) *Didymodon trifarius* (in the modern sense) is not known for Finland (KOPONEN 1979) but *S. glaucescens* is (KOPONEN et al. 1977), it seems certain that no bryologist in the near future will successfully designate a lectotype for *D. trifarius* that will preserve current usage. Following the lead of DIXON (1924) and LIMPRICHT (1890), I here treat the name *D. trifarius* as a nomen ambiguum. The unambiguous name *D. vinealis* var. *luridus* is appropriate for that taxon of *Didymodon* commonly identified as «*D. trifarius*» in European herbaria but seldom so in American herbaria.

The J.E. Smith herbarium (LINN) is extraordinary, by the way, for its richness in well-labeled (Pl. VII, fig. 2) early specimens, many of which are possible isotypes or are otherwise representative of taxonomic concepts of early authors of bryophyte names. Some persons who apparently corresponded with Smith and sent him specimens include : Davall, Davies, Dickson, Hedwig, Hooker, Humboldt, Linneus, Mackay, Menzies, Muehlenberg, Schrader, Swartz, Torrey and Turner. The Smith bryophyte herbarium is presently under the same regulations as those for the Linnean collections at LINN. These allow low-power microscopic examination only (without manipulation or dissection of the specimen) and are not appropriate for taxonomic study of bryophytes. One might hope that the Smith herbarium might someday be transferred to BM where facilities are more suited to the needs of specialists on the bryophytes.



Pl. VII. - 1 : Sample specimens in J. Dickson herbarium at BM showing typical lack of collection data. 2 : Sample label of a sheet in J.E. Smith herbarium at LINN showing relative excellence of collection data.

The name *Barbula lurida* Hornsch. in Mart. may be confused with *Didymodon luridus* Hornsch. in Spreng. The former is based on a different type (from

Brazil) and the specimen reported (CRUM 1951) under this name from Mexico (Nuevo León, Harvey 1061 - MICH) is *Barbula arcuata* Griff.

Habitat : soil, rock, riverside, dry to moist areas, to 1570 m elevation.

Distribution : Mexico : México; California.

Range : western North America, Central America, Europe, Middle East, Asia, Africa.

North American specimens examined : U.S.A. : Washington, Klickitat-Franklin counties border, ca. 48 km E of Plymouth, soil and steppe, McIntosh & Kruckeberg 4902 (UBC). Arizona, Cococino Co., Oak Creek Gorge, West Fork, Zander 4150 (BUF). California, Lassen Co., 24 km S of Adin, limestone outcrop, Norris 21462 (HSC); Tehama Co., Woodson Bridge State Park, Norris 50430 (HSC). Mexico : México, Tlalmanalco, 3 km E of San Rafael, Cárdenas 56 (MEXU, TENN). Guatemala : Quetzaltenango, below Zunil, along Río Samalá, Steyermark 34985 (FH).

— *Didymodon vinealis* var. *nicholsonii* (Culm.) Zander, comb. nov.

Didymodon nicholsonii Culm., *Rev. Bryol.* 34 : 100. 1907, basionym.

Type : England, Sussex, Wild Brooks, Amberley, Nicholson, 1905 (BM). —

Barbula nicholsonii Culm., *Rev. Bryol.* 34 : 100. 1907. — *Didymodon*

rigidulus var. *nicholsonii* (Culm.) Roth, *Hedwigia* 50 : 303. 1911. — *Barbula*

rigidula ssp. *nicholsonii* (Culm.) Dix., *Stud. Handb. Brit. Moss. ed.* 3 :

413. 1924. — *Didymodon luridus* ssp. *nicholsonii* (Culm.) Loesk., *Ber.*

Naturh. Ver. Preuss. Rheinl. Westf. 1932-33 : 16. 1934. — *Didymodon*

luridus var. *nicholsonii* (Culm.) Loesk. in WIRTGEN, *Herb. Fl. Rhen.*

n. 826. 1934. — *Didymodon trifarius* ssp. *nicholsonii* (Culm.) Wijk &

Marg., *Taxon* 7 : 289. 1958.

Leaves rigid, long-ovate, occasionally ovate-lanceolate, to 3.5 mm long; leaf apex broadly acute to blunt, somewhat cucullate; leaf margins recurved to near apex; upper laminal cells 7-9 μ m wide, weakly papillose, walls evenly thickened, upper marginal cells evenly bistratose or nearly so. **Illustration** : Pl. V, fig. 9-12.

Except for the type specimen, which is K red-brown, the laminal color reaction of this variety is K orange-brown to red-orange-brown. The var. *nicholsonii* is fairly sharply differentiated from var. *luridus* by its evenly bistratose upper marginal cells, but it intergrades with var. *vinealis*. *Didymodon rigidulus* var. *incrassatolimbatus* is very similar in appearance to var. *nicholsonii*; however, the latter differs var. *incrassatolimbatus* by its filamentous, yellow peristome (vs. the long-triangular, red-orange peristome of var. *incrassatolimbatus*); perichaetial leaves ovate-lanceolate, weakly differentiated (vs. narrowly lanceolate, unlike the cauline leaves); cauline leaves keeled (vs. plane); leaf apex somewhat cucullate, occasionally apiculate by one conical cell (vs. apex plane, costa short-excurrent as a cone or cylinder); costa bulging dorsally, brown (vs. little bulging dorsally, green); and adaxial stereid band represented only by thin-walled or substereid cells (vs. stereid cells usually present adaxially).

Contrary to indication in the Index Muscorum (VAN DER WIJK et al. 1959-69), *Didymodon nicholsonii* Culm. was validly published together with *Barbula nicholsonii* Culm., being one of two «alternative names» (I.C.B.N., Art. 34).

Habitat : soil, rock, dry to moist situations, 90-1370 m elevation.

Distribution : California.

Range : western North America, western Europe. Reported here as new to the New World.

Specimens examined : U.S.A. California : Humboldt Co., Mad R., near Maple Creek, Schofield 28662 (UBC); Mendocino Co., Navaro R. near entrance to Hendy Woods State Park, Norris 53101 (UBC); Ventura Co., Howard Creek Trail, Norris 55495 (HSC); Chorro Grande Canyon, Norris 55543 (HSC). Oregon : Lake Co., Lakeview, canyon at end of Center St., streamside, Zander & Eckel 4422 (BUF). Canada. British Columbia : S of Cristina Lake, Kettle R. Gorge, Tan & Teng 78-119 (UBC). England. Gloucestershire : Symonds Yat, Townsend, 1957 (US); Northumberland : Linshiels, Coquet R., Long 4903 (E). Germany (BRD). Neuwied, Düll 7.4.1979 (BUF).

- *Didymodon vinealis* var. *rubiginosus* (Mitt.) Zander, comb. & stat. nov.
Barbula rubiginosa Mitt., J. Linn. Soc. Bot. 8 : 27. 1864, basionym. —
Didymodon occidentalis Zander, Phytologia 41 : 26. 1978, non *Didymodon rubiginosus* (C. Muell.) Broth., Nat. Pfl. 1 (3) : 405.1902.

Leaves rather rigid, long-lanceolate, to 3.0 mm long; leaf apex narrowly acute, grooved to terete, margins recurved to above midleaf; upper laminal cells relatively large, 10-13 μ m wide, weakly papillose, pellucid, walls evenly thickened to somewhat porose, upper marginal cells unistratose or more commonly bistratose in patches or entirely. **Illustration** : Pl. V, fig. 6-7.

This taxon is confined to the West Coast of North America. It is characterized by the acuminate leaf apex that is often bistratose marginally or entirely, occasionally somewhat notched and appearing fragile, and the rather large upper laminal cells. The peristome often appears to be absent, but actually is removed with the operculum. This and the character of quadrate basal laminal cells are variable and present in other varieties occasionally. LAWTON (1971) notes that «rudimentary peristome is occasionally present».

Habitat : bark, rock, soil, wet to dry situations, to 1100 m elevation.

Distribution : California.

Range : I have seen specimens from Canada : British Columbia; U.S.A. : Oregon and California; LAWTON (1971) reports it also from Washington and Idaho.

- *Didymodon vinealis* var. *flaccidus* (B.S.G.) Zander, Phytologia 41 : 25. 1978.
Barbula vinealis var. *flaccidus* B.S.G., Bryol. Eur. 2 : 86. 1842 (fasc. 13-15 Mon. 24).

Leaves long-lanceolate, to 4.0 mm long, often flexuose or twisted when wet;

leaf apex narrowly acute to blunt, grooved adaxially; laminal margins plane above midleaf; upper laminal cells 7-10 μm wide, usually distinctly papillose, walls usually thin, upper marginal cells usually unistratose. ■ = 13 or 13 + 1m. **Illustration** : Pl. V, fig. 8.

The var. *flaccidus* is red-brown with KOH. I agree with STEERE's (1938) evaluation that «the longer and much more flexuous leaves, which are less strongly revolute, and the more papillose cells...» are characteristic of this taxon; STEERE, who treated this under the name *Barbula cylindrica* (Tayl.) Schimp., also recognized a degree of intergradation with what is here var. *vinealis*, such being more apparent in the south of its range in North America.

Habitat : soil, rock, to 3000 m elevation.

Distribution : California.

Range : western U.S.A., western Canada, Europe, northern Africa, Asia.

EXCLUDED NAMES

Barbula and *Didymodon* species reported for Mexico and California that have not been previously treated (ZANDER 1978a, b, 1979) are discussed below, together with a few other names of taxa from Central America or the Antilles.

Barbula lonchostegia C. Muell., *Bull. Herb. Boiss.* 5 : 195. 1897. **Type** : Guatemala, between Cubulco and Soyabaji, Bernoulli & Cario 104 (NY - isotype). = *Barbula indica* (Hook.) Spreng. emend. Zander (1979) (syn. nov.).

Barbula graminicolor C. Muell., a synonym of *Didymodon australasiae* (Hook. & Grev.) Zander, was reported from Mexico (BESCHERELLE 1872) on the basis of a specimen (Veracruz, Orizaba, Liebmann s. n. - BM!) that is actually *Barbula orizabensis* C. Muell.

Barbula lurida Hornsch. in Mart. This is a Brazilian species reported (CRUM 1951) from Mexico based on a specimen (Nuevo León, Hacienda Hermosa, Harvey 1061 - MICH!) that proved to be *Barbula arcuata* Griff. The former name may, however, be a synonym and predates the latter.

Barbula saint-pierrei Thér., *Rev. Bryol. et Lichénol.* 5 (1932) : 97. 1933. **Type** : Mexico, D.F., Cuautzin, Saint-Pierre 1879 (NY, PC - isotypes). = *Bryoerythrophylum ferruginascens* (Stirt.) Giac. (syn. nov.).

Didymodon filicaulis Card., *Rev. Bryol.* 37 : 126. 1910. **Type** : Mexico, México, Ixtaccihuatl, Purpus 3721 (PC - holotype; NY - isotype). = *Bryoerythrophylum recurvirostre* (Hedw.) Chen var. *recurvirostre* (syn. nov.), malformed leaves.

Didymodon juniperinus (C. Muell.) Broth., a Peruvian species, was reported (BOWERS et al. 1973) from Mexico on the basis of a specimen (Puebla, Sharp 948-a - TENN!) that proved to be *Oxystegus tenuirostris* (Hook. & Tayl.) A.J.E. Sm. var. *tenuirostris*.

Didymodon planifolius P. Varde & Thér., *Rev. Bryol. Lichénol.* 14 : 11. 1944.

Type : Haiti, Morne de la Selle, Eckman 3178 (MICH). = *Trichostomum brachyodontium* Bruch in F.A. Muell. (syn. nov.).

Husnotiella obtusifolia (Hampe) Zander. This combination (ZANDER 1977) has proved to be inappropriate and the correct name for the taxon is *Gyroweisia obtusifolia* Broth. (nom. nov. for *Trichostomum obtusifolium* Hampe, 1870, hom. illeg. non *T. obtusifolium* P. Beauv., 1805). Relationship to the genus *Husnotiella* (treated here as a synonym of *Didymodon* and for which the generitype is *D. revolutus*) was misevaluated because of similarities in leaf shape and papillae; mixture of *G. obtusifolia* and *D. revolutus* in the type of *G. papillosa* Thér., a synonym, and in other specimens; both species have leaf margins bistratose in small patches, convex adaxial costal surfaces and quadrate-adaxial costa cells; and because of the fact that specimens of *D. revolutus* may rarely have plane leaf margins. *Gyroweisia obtusifolia* differs from *D. revolutus* by the following combination of characters : capsule microstomous, annulus revoluble or adherent; peristome red-brown, somewhat twisted, teeth long, filamentous and acute; leaves ligulate, plane, basal cells enlarged, swollen, hyaline and thin-walled; adaxial costal cells short-rectangular to elongate; costa with two stereid bands (the adaxial one occasionally substereid). Although my comments (ZANDER 1977) that *Gyroweisia* is a «wastebasket» genus still hold, *G. obtusifolia* can be referred to the genus *Gyroweisia* by the following combination of characters : annulus often revoluble; peristome teeth short; leaves occasionally cucullate, margins plane, basal cells much enlarged; costa subpercurrent, adaxial costal cells occasionally elongate; upper laminal cell papillae several over each lumen each side.

SUMMARY OF NEW SYNONYMS

(Basionyms arranged by epithet; emendations refer to this paper unless otherwise noted)

- Barbula alitseta* Card. = *Didymodon rigidulus* Hedw. emend. Zander
B. bescherellei var. *crassinervia* Thér. = *D. rigidulus* Hedw. emend. Zander
B. bescherellei var. *stenocarpa* Card. = *D. rigidulus* Hedw. emend. Zander
B. bourgaeana Besch. = *D. vinealis* (Brid.) Zander emend. Zander
D. craspedophyllus Card. = *D. australasiae* (Hook. & Grev.) Zander emend. Zander
B. erythropoda Schimp. ex Besch. = *D. rigidulus* Hedw. emend. Zander
D. filicaulis Card. = *Bryoerythrophyllum recurvirostre* (Hedw.) Chen var. *recurvirostre*
B. flaccidiseta Lor. = *D. rigidulus* Hedw. emend. Zander
D. fusco-viridis Card. = *D. rigidulus* Hedw. emend. Zander
B. godmaniana C. Muell. = *D. rigidulus* Hedw. emend. Zander
B. gracilescens Schimp. ex Besch. = *D. rigidulus* Hedw. emend. Zander
B. graciliformis Schimp. ex Besch. = *D. rigidulus* Hedw. emend. Zander
B. graminicolor C. Muell. = *D. australasiae* (Hook. & Grev.) Zander emend. Zander
D. heribaudii Card. = *D. rigidulus* Hedw. emend. Zander
B. lagunicola C. Muell. = *D. rigidulus* Hedw. emend. Zander
B. leptocarpa Besch. = *D. rigidulus* Hedw. emend. Zander
B. lonchostega C. Muell. = *B. indica* (Hook.) Spreng. emend. Zander (1979)
B. lozanoi Card. = *D. vinealis* (Brid.) Zander emend. Zander
D. mexicanus Besch. = *D. rigidulus* Hedw. emend. Zander

- B. mobilis* C. Muell. = *D. rigidulus* Hedw. emend. Zander
Tortula olivacea Besch. ex Mitt. = *D. vinealis* (Brid.) Zander emend. Zander
D. patentifolius Thér. = *D. australasiae* (Hook. & Grev.) Zander emend. Zander
D. planifolius P. Varde & Thér. = *Trichostomum brachydontium* Bruch in F.A. Muell.
D. pusillus Card., hom. illeg. = *D. rigidulus* Hedw. emend. Zander
Trichostomum ramulosum Schimp. ex Besch. = *D. rigidulus* Hedw. emend. Zander
B. rectifolia Tayl. = *D. vinealis* (Brid.) Zander emend. Zander
B. rigidula Besch., hom. illeg. = *D. rigidulus* Hedw. emend. Zander
B. saint-pierrei Thér. = *Bryoerythrophyllum ferruginascens* (Stirt.) Giac.
B. salazarensis Thér. = *D. vinealis* (Brid.) Zander emend. Zander
B. strictidens C. Muell. = *D. rigidulus* Hedw. emend. Zander
B. subteretiuscula Card. = *D. rigidulus* Hedw. emend. Zander
B. teretiuscula Schimp. ex C. Muell. = *D. rigidulus* Hedw. emend. Zander
D. torquesens Card. = *D. australasiae* (Hook. & Grev.) Zander emend. Zander
D. viridissimus Card. = *D. rigidulus* Hedw. emend. Zander
D. sect. Craspedophyllum Card. = *D. sect. Asteriscium* (C. Muell.) Zander

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ESTUDIO BRIOSOCIOLOGICO DE LAS COMUNIDADES REOFILAS DE SIERRA NEVADA (ESPANA)

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RÉSUMÉ. — On fait une étude bryosociologique des groupements rhéophiles de la Sierra Nevada, avec la description des associations suivantes : *Scapanietum undulatae* Schwickerath 1944, *Dichodontietum pellucidi* v. Hübschmann 1967, *Fontinaleto-Pachyffissidentetum grandifrondis* W. Koch 1936, à rattacher à la classe *Platyhypnidio-Fontinaletea* Philippi 1956.

De même on a étudié les groupements rhéophiles alpins de la classe *Hygrohypnetea* v. Hübschmann 1957, avec les associations *Schistidio-Hygrohypnetum dilatati* Geissler 1976 et *Solenostomo-Hygrohypnetum* Geissler 1976.

GENERALIDADES

1. Geología y climatología. — El desarrollo de Sierra Nevada como conjunto montañoso netamente individualizado, tiene lugar principalmente durante el Plioceno y, es en el Cuaternario cuando los períodos activos periglaciares determinan el decisivo modelado de su relieve. El resultado es una zona ó región central constituida por micasquistos, que poseen un considerable contenido en granates y grafitos, además de cuarcitas, gneis, anfibolitas, serpentinitas y mármoles, materiales de edad anterior a la era secundaria; este núcleo central queda envuelto por una zona periférica u orla calizo-dolomítica del Triásico.

Las diferencias altitudinales determinan las lógicas variaciones climáticas; así, las zonas comprendidas en el piso supramediterráneo (RIVAS MARTINEZ, 1981) registran una precipitación media anual de 650 mm (a 1084 m), mientras las zonas situadas en el piso oromediterráneo (2000 m) suelen sobrepasar los

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900 mm (no se dispone de datos pluviométricos fiables para el crioromediterráneo, es decir, entre 2800 y 3000 m). La temperatura media anual del piso mesomediterráneo es de 15,8°C (a 900 m), descendiendo a 4,7°C (a 2700 m) en el límite entre los pisos oro- y crioromediterráneo. Para las zonas situadas entre 2000 y 2500 m la duración de la nieve comprende de cuatro a cinco meses al año, mientras que en altitudes superiores oscila entre siete y ocho meses y permaneciendo de forma permanente tan sólo en algunos ventisqueros.

2. Hidrografía e hidrología. — La mayoría de los cursos nevadenses tienen sus nacimientos a partir de lagunas que proceden del deshielo estando situadas, entre 2700 y 3000 m, al pie de accidentadas crestas que denotan las huellas dejadas en la montaña por los glaciares cuaternarios del Pleistoceno; los ríos procedentes de ellas muestran caracteres erosivos incompletos, de lo que se deduce la fase de inmadurez que aún poseen, susceptibles por tanto de transformarse y desgastarse todavía más.

En las cuencas nevadenses el deshielo actúa como regulador del caudal, ya que las cantidades sustraídas en los meses de máxima precipitación son luego aportadas en los meses de mayor sequía. Los ríos nevadenses poseen pues, un régimen de tipo pluvial pero de intensa influencia nival en verano, haciéndose torrenciales y de caudal constante en sus tramos más elevados (entre 2000 y 3000 m); sin embargo en los tramos medio y basal, el caudal experimenta notables variaciones desde principios a final del estío. También se aprecia un fuerte contraste respecto a las temperaturas y calidades químico-biológicas de las aguas, frías (rara vez superan 4°C), ácidas (pH = 4,5-5) y oligótrofes al principio, haciéndose después más cálidas (10°C), mesótrofes y de pH próximo a la neutralidad.

ESTUDIO BRIOSOCIOLOGICO

Los trabajos briosociológicos realizados por KRAJINA (1933), HÜBSCHMANN (1953, 1957, 1967, 1973), PHILIPPI (1956, 1965), HERTEL (1974) y GEISLER (1976), constituyen la base de nuestro estudio sobre las comunidades reófilas nevadenses, agrupándolas para ello en las clases *Platyhypnidio-Fontinaletea* Philippi 1956 = *Hygrohypnetea* v. Hübschmann 1957.

Ambas clases se caracterizan por ser hidrófilo-reófilas y pioneras en la colonización de cursos de agua. Son pobres en especies y particularmente sensibles a diversos factores limitantes (contaminación, fuertes oscilaciones del caudal, variaciones del pH, etc.), por lo que habitualmente presentan un desarrollo fragmentario.

GEISLER (1976) ha establecido en los Alpes suizos una disposición catenal de ambas clases, localizándose la clase *Hygrohypnetea* entre los pisos alpino y subalpino centroeuropeos (no desciende por debajo de 1300 m), mientras que la clase *Platyhypnidio-Fontinaletea* se halla relegada a los pisos montano y colino.

Esta situación no se reproduce tan exactamente en Sierra Nevada, pues a partir de los inventarios levantados por encima de 2400 m, se puede comprobar la presencia de una u otra clase con independencia de su altitud. Probablemente la latitud del macizo nevadense determina que ambas clases se hallen interpuestas en el seno de los pisos oromediterráneo y criomediterráneo, actuando como factor limitante en el establecimiento de las mismas la mayor o menor torrencialidad del agua.

1. CLASE *PLATYHYPNIDIO-FONTINALETEA* Philippi 1956

Las comunidades reofilo-acidófilas del piso montano centroeuropeo se han incluido tradicionalmente en la clase *Brachythecietea plumosi* v. Hübschmann 1957, así como las basófilas de llanuras en la clase *Fontinaletea antipyreticae* v. Hübschmann 1957; no obstante, a partir de los estudios realizados por PHILIPPI (1956) y HERTEL (1974), ambas clases podrían quedar reunidas en una única clase *Platyhypnidio-Fontinaletea* Philippi 1956. Dicha clase está representada en Sierra Nevada por los ordenes *Brachythecietalia plumosi* Philippi 1956 y *Leptodictetalia riparii* Philippi 1956.

1.1. ORDEN *BRACHYTHECIETALIA PLUMOSI* Philippi 1956

Se halla representado por la alianza de comunidades sumergidas y acidófilas *Scapanion undulatae* Philippi 1956. La alianza de comunidades anfibias y acidófilas *Racomitrium acicularis* Krusenstjerna 1945 no alcanza su óptimo en Sierra Nevada, pues el deshielo mantiene constante el nivel de los ríos en los tramos superiores, así como el carácter básico del agua en los tramos basales impide el establecimiento de la comunidad. La alianza *Scapanion undulatae* está representada a su vez por la asociación *Scapanietum undulatae* Schwickerath 1944.

A) ASOCIACION *SCAPANIETUM UNDULATAE* Schwickerath 1944

Estructura y composición florística : tab. 1. Origen de los inventarios : tab. 1. N° 1, 11 : 2840, 2800 m - Río Dilar : 4.9.74. N° 2, 3, 14 : 2380, 3000, 2850 m - Río Seco : 6.8.75. N° 4, 5, 6 : 2450, 2600, 2400 m - Chorreras del Monte Cuna : 26.7.75. N° 7, 8, 9 : 1800, 1860, 2900 m - Arroyo de la Ragua : 21.6.76. N° 10, 12 : 2700, 2900 m - Siete Lagunas : 13.8.76. N° 13 : 2700 m - Río Trevélez : 13.8.76.

Sinecología. — Comunidad acidófila y fotófila, de aguas frías que rara vez sobrepasan los 15°C de temperatura media, y que no soporta fuertes variaciones hidrostáticas; es por esto que suele situarse sobre esquistos sumergidos o semi-sumergidos, que constituyen los tramos superiores de los ríos de Sierra Nevada (1800-3000 m), preferentemente en estaciones donde la escorrentía no es excesivamente torrencial.

Sinfisionomía. — Comunidad abierta (cobertura media = 61%), para una

Número de inventario	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Superficie(dm ²)	12	10	16	10	12	16	13	12	13	11	12	25	15	16
Cobertura(%)	60	40	40	30	80	80	70	70	70	60	60	60	60	■
Exposición	NE	0	SE	■	■	S	S	SE	SE	S	■	NO	S	E
Inclinación(°)	■	10	■	0	45	45	45	90	90	90	10	60	■	60
Sustrato	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Número de especies	5	2	2	3	3	3	4	3	3	■	3	2	4	2

2,8

Características de asociación y alianza(*Scapanietum undulatae*, *Scapanion undulatae*):

<i>Scapania undulata</i>	+	1	1	2	1	1	1	2	3	1	3	1	1	3	V
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Características de unidades superiores(*Brachythecietella plumosa*, *Platyhypnidio-Fontinalis*):

<i>Brachythecium rivulare</i>	+	+	+	+	+	+	2	3	+	+	+	+	+	+	III
<i>Schistidium rivulare</i>	+	2	3	+	+	+	+	+	+	+	+	+	+	+	II
<i>Fontinalis antipyretica</i>	+	+	+	3	3	4	+	+	+	+	+	+	3	+	II
<i>Platyhypnidium riparioides</i>	+	+	+	+	+	+	+	+	+	3	+	+	1	+	I
<i>Dichodontium pellucidum</i>	2	+	+	+	+	+	+	+	+	+	+	+	+	+	I

Compañeras:

<i>Bryum schleicheri</i>	1	+	+	+	+	+	+	+	1	1	+	+	+	+	II
<i>Philonotis serotina</i>	3	+	+	+	+	+	+	+	+	+	+	+	1	+	I
<i>Solenostoma cordifolium</i>	+	+	+	+	+	+	+	+	+	+	3	3	+	+	■
<i>Cratoneuron declivens</i>	+	+	+	+	+	+	+	+	+	+	1	+	+	+	I
<i>Chylocladus polyanthus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>var. rivulare</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	I

Leyenda: M=Micasquistos

Tab. 1 — *Scapanietum undulatae* Schwickerath 1944.

superficie de inventarios media de 14 dm², con un número específico medio de 2,9 (variaciones de 2 a 5). La asociación viene esencialmente configurada en su fisionomía por los *Bryochamaephyta reptantia*, *Scapania undulata* y *Brachythecium rivulare*, aspecto que se halla reforzado por las restantes especies de la asociación como, *Platyhypnidium riparioides* y *Fontinalis antipyretica*. La única especie de biótipo cespitoso, *Schistidium rivulare*, no alcanza índices suficientemente grandes que puedan influir en forma decisiva en la fisionomía. Lo más destacable en la fisionomía de la asociación es su carácter fragmentario, pues son pocas las veces que pueden inventariarse la totalidad de las especies diferenciales.

Sindinámica. — Las especies pioneras *Scapania undulata* (V) y *Brachythecium rivulare* (III) son las que tienden a ocupar el mayor área posible en las rocas sumergidas. El desarrollo de las restantes especies de la comunidad es fragmentario y variable, pues mientras *Fontinalis antipyretica* (II) suele establecerse en lugares algo protegidos del impacto directo de la corriente, *Schistidium rivulare* (II) y *Platyhypnidium riparioides* (I) prefieren sin embargo estaciones donde es superior la torrencialidad del agua. Es precisamente en dichas estaciones donde se produce el tránsito hacia las comunidades de *Hygrohypnetea*,

la mayor parte de las veces hacia *Schistidio-Hygrohypnetum dilatati* Geissler 1976; sólo en aquellas estaciones donde la escorrentía no es excesivamente grande, la comunidad evoluciona hacia *Solenostomo-Hygrohypnetum* Geissler 1976.

En rocas próximas a los bordes de los ríos, la asociación es rápidamente invadida por las comunidades de la alianza *Montion* (Br. Bl. 1925) Maas 1959, produciéndose la sucesión desde comunidades saxícolas y pioneras hacia comunidades helofíticas, terri-saxícolas y terrícolas secundarias.

Sintaxonomía. — La asociación descrita por SCHWICKERATH (1944), fué posteriormente confirmada por KRUSENSTJERNA (1945) quien la incluyó en la alianza *Racomitrium acicularis*. Sin embargo, el carácter anfibio de que goza esta alianza determinó que PHILIPPI (1956) situara a la asociación en su nueva alianza *Scapanion undulatae*, más acorde con la tendencia de la misma a permanecer sumergida.

Sincorología. — La asociación se halla ampliamente distribuida en Europa, con preferencias en las zonas montañosas de Centroeuropa y regiones escandinavas. También ha sido descrita por HÜBSCHMANN (1971) en la isla de Madera. En la Península Ibérica disponemos de algunas referencias en estudios realizados por V. et P. ALLORGE (1947) y CASAS (1958); a partir de dichos trabajos se deduce una distribución adscrita a las regiones de abundante precipitación y sustrato ácido, como Galicia, noroeste de Portugal y afloramientos graníticos de las montañas astures, vascas y catalanas, sierras de Guadarrama y Albarracín. En el sur de la Península sólo tenemos las referencias de V. et P. ALLORGE (1945) para las sierras de Algeciras, lo que unido a nuestra cita correspondería a su localización más meridional en Europa.

1.2. ORDEN LEPTODYCTIETALIA RIPARII Philippi 1956

El orden de comunidades basófilas *Leptodyctietalia riparii*, está representado en Sierra Nevada por la alianza de comunidades anfibias submontanas *Brachythecion rivularis* Hertel 1974, y probablemente la alianza de comunidades sumergidas *Fontinalion antipyreticae* Koch 1936.

La alianza *Brachythecion rivularis* comprende asociaciones anfibias, capaces de resistir un período de desecación más o menos prolongado. En las zonas basales de la sierra, los caudales acusan extremadas fluctuaciones durante el verano, llegando en ocasiones a una sequía casi total, con lo que se anula el posible desarrollo de la alianza; en las partes altas sin embargo el aforo es continuo, por lo que apenas si varía el caudal. En consecuencia, las estaciones que potencialmente debiera ocupar la alianza son normalmente colonizadas por *Scapanion undulatae* o *Montion*, exceptuando algunos nichos más protegidos de la corriente en que se establece *Brachythecion rivularis*, representada por la asociación *Dichodontietum pellucidi* v. Hübschmann 1967.

La presencia de la alianza *Fontinalion antipyreticae* se manifiesta probablemente mediante la asociación *Fontinaleto-Pachyissidentetum grandifrons*

Koch 1936, comunidad que permanece sumergida gran parte del año y de netas preferencias basófilas. Sin embargo, de acuerdo con lo expresado por BOROS (1968) y HERTEL (1974), hay que tener presente que la especie que da nombre a la alianza, *Fontinalis antipyretica*, es en realidad indiferente respecto del pH (entre 5,4 y 7,7). Todo ello hace de la alianza en cuestión una unidad sintaxonómica incierta y heterogénea; no obstante, seguimos adoptando de momento la tradicional inclusión de *Fontinaleto-Pachyissidentetum grandifrondis* dentro de la alianza *Fontinalis antipyreticae*.

Dicha alianza está ausente de la zona esquistosa de la sierra, relegándose a las formaciones calizas basales, donde alcanza un precario desarrollo en consecuencia a la escasa calidad biológica de las aguas así como por las fuertes variaciones de los caudales en el periodo estival.

B) ASOCIACION *DICHODONTIETUM PELLUCIDI* v. HÜBSCHMANN 1967

Estructura y composición florística : tab. 2. Origen de los inventarios : tab. 2. Nº 1, 2, 10 : 2880 m. Nº 3 : 2870 m - Laguna de las Vegas : 2.8.73. Nº 4 : 2770 m. Nº 5, 8, 9 : 2700 m - Rio Guarnón : 10.7.76. Nº 6, 7 : 2450, 2470 m - Rio Maitena : 13.7.77.

Sinecología . — Asociación reófila que muestra notables diferencias ecológicas respecto a otras comunidades de carácter semejante. Estas diferencias son, una patente esciofilia que provoca su localización en oquedades protegidas y umbrías, un marcado carácter anfíbio que le hace mostrarse sumergida en los primeros momentos del estío y expuesta a desecación en los meses finales; por último, es asimismo notable su indiferencia respecto del pH del agua. *Dichodontietum pellucidi* responde pues a un comportamiento higró-hidrófilo, esciófilo e indiferente respecto al sustrato, a diferencia de las otras asociaciones reófilas de carácter exclusivamente hidrófilo, fotófilo y acidófilo estricto.

Sinfisionomía . — A la diferencia de la comunidad anterior, *Dichodontietum pellucidi* se muestra como asociación un tanto más cerrada (cobertura media = 51%), para una superficie de inventarios media de 12,3 dm², con un número específico medio de 4 (variaciones de 2 a 6). Asimismo, las diferencias fisionómicas se ven potenciadas por el predominio que establece *Dichodontium pellucidum* (V) (briocaméfito cespitoso-pulvinular) sobre los briocaméfitos reptantes, como *Cratoneuron decipiens* (II), *Brachythecium rivulare* (II), *Cratoneuron commutatum* var. *irrigatum* (II), *Solenostoma pumilum* (II) y *Solenostoma cordifolium* (II).

Sindinámica . — La asociación descrita por HÜBSCHMANN (1967), posee entre otras las siguientes especies : *Dichodontium pellucidum*, *Platyhypnidium riparioides*, *Schistidium rivulare*, *Scapania undulata* y *Brachythecium rivulare*; de todas ellas, la única que aparece regularmente en la asociación nevadense es *Dichodontium pellucidum*, pues *Brachythecium rivulare* está presente tan sólo en cuatro de los inventarios. Es evidente por otra parte la presencia de un elevado número de especies, compañeras de las anteriores, que en su mayoría

tienen carácter terrícola o terrisaxícola, así como un comportamiento mesohigrófilo. La mayor parte de ellas pertenecen a diferentes asociaciones de la clase *Montio-Cardaminetea* Br. Bl. et Tx. 1943, que son las que generalmente ocupan las estaciones potencialmente colonizables por la asociación *Dichodontietum pellucidi*. En definitiva, podemos concluir que en Sierra Nevada sólo disponemos de una representación fragmentaria de la asociación estudiada.

Número de inventario	1	2	3	4	5	■	7	8	9	10
Superficie(dm ²)	12	10	10	10	12	20	10	15	12	12
Cobertura(%)	70	60	40	40	80	80	60	30	30	20
Exposición	NE	N	N	N	N	NE	N	N	■	N
Inclinación(°)	40	70	80	70	80	40	■	90	90	60
Sustrato	M	M	M	M	M	M	M	M	M	M
Número de especies	6	4	3	6	3	3	5	5	3	2

Característica de asociación:

Dichodontietum pellucidum

fo. fogimontanum	2	3	2	1	1	3	1	+	1	2	V
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Características de unidades superiores(*Brachythecium rivularis*,
Leptodictylella riparia, *Platyhypnidia-Fontinaletea*)

<i>Brachythecium rivulare</i>	2	.	1	.	.	.	.	1	.	.	II
<i>Scapania undulata</i>	+	1	.	+	.	.	.	.	.	.	II

Compañeras:

<i>Solenostoma cordifolium</i>	.	.	.	=	.	+	+	2	1	.	III
<i>Solenostoma pumilum</i>	2	.	.	.	+	.	.	+	2	.	II
<i>Bryum schelcheri</i>	1	1	.	1	.	.	1	.	.	.	II
<i>Cratoneuron decipiens</i>	2	2	3	.	.	.	.	.	.	.	II
<i>Cratoneuron commutatum</i> var. <i>irrigatum</i>	.	.	.	2	4	2	2	.	.	.	II
<i>Philonotis seriata</i>	.	.	.	+	.	.	.	+	.	.	I
<i>Amphidium mougeotii</i>	.	.	.	.	.	.	.	.	.	3	I

Leyenda: M=Micasquistos

Tab. 2. — *Dichodontietum pellucidi* v. Hübschmann 1967.

Sintaxonomía. — Dado su carácter montano la asociación fué incluida en la alianza *Scapanion undulatae* por HÜBSCHMANN (1967). Dicho autor (1973), reestructura la sintaxonomía de las comunidades briofíticas reófilas y en conso-

nancia con su carácter anfíbio sitúa a la asociación en la alianza *Racomitrium acicularis*. Sin embargo, este sintaxon sólo reúne asociaciones estrictamente acidófilas, lo que no es consecuente con la indiferencia que manifiesta *Dichodontietum pellucidi* respecto al sustrato; este aspecto ya ha sido anteriormente reseñado por HÜBSCHMANN (1967, 1973).

La presencia simultánea de *Dichodontietum pellucidum* y *Brachythecium rivulare* que evidencia nuestra asociación, constituye para nosotros un aspecto bastante significativo, pues también se puede constatar en las comunidades reófilas estudiadas por HERZOG (1944), HÜBSCHMANN (1973), NORR (1969) y HERTEL (1974). Todo ello nos parece lógico, si consideramos que *Brachythecium rivulare* también se comporta como anfibia e indiferente al sustrato. La coexistencia de ambas, parece relacionada con una tendencia por parte de las especies de *Montio-Cardaminetea* para invadir las comunidades ya establecidas de *Dichodontietum pellucidi*. En este sentido, en opinión de HÜBSCHMANN (1973), *Brachythecium rivulare* sería más bien un vínculo entre las comunidades briofíticas reófilas y las helofíticas de las alianzas *Montion* (Br. Bl. 1925) Maas 1959, *Cardaminion* Maas 1959 y *Cratoneurion commutari* W. Koch 1928. En consecuencia, la alianza *Brachythecion rivularis* incluiría asociaciones que, como *Dichodontietum pellucidi*, representan la transición entre las comunidades estrictamente reófilas, y las de la clase *Montio-Cardaminetea* que están en íntimo contacto con ellas.

Sincorología. — Según HÜBSCHMANN (1967), la asociación se extiende por toda Europa en ríos de alta y media montaña, Cáucaso, Japón y América del Norte. No conocemos con precisión su areal peninsular, pero la distribución y características ecológicas de la especie directriz, permiten suponer su presencia en algunas de las regiones montañosas del norte de la Península Ibérica.

C) ASOCIACION FONTINALETO-PACHYFISSIDENTIETUM GRANDIFRONDIS
W. Koch 1936

Estructura y composición florística : tab. 3. Origen de los inventarios : tab. 3. Nº 1 : 1000 m - Río Genil : 13.2.76. Nº 2 al 8 : entre 1200 y 1370 m - Río Aguas Blancas : 20.4.77.

Sinecología. — Comunidad reófila que permanece siempre sumergida, colonizadora de arroyos y ríos de aguas apenas contaminadas y ricas en cal (pH = 7-8,5). Por tanto, actúan como factores limitantes la eutrofía del agua y la oscilación del caudal.

Aunque de forma precaria, la asociación aparece en la orla calizo-dolomítica basal de la sierra; el limitado desarrollo que alcanza se debe en parte a la fuerte sequía estival, así como a la notable filtración y absorción de aguas que caracteriza a la topografía calcárea; existe además una extensa red de acequias y una creciente contaminación.

Sinfisionomía. — La comunidad participa de un doble aspecto fisionómico,

conferido por la presencia simultánea de *Fissidens grandifrons* (*Bryochamaephyta caespitosa*) (V) y *Platyhypnidium riparioides* (*Bryochamaephyta reptantia*) (V). En cualquier caso, la asociación es abierta (cobertura media = 52^o/o), para una superficie de inventarios media de 16,1 dm², con un número específico medio de 3,5 (variaciones de 2 a 5).

Número de inventario	1	2	3	4	5	6	7	8	
Superficie(dm ²)	10	15	20	16	10	18	15	25	
Cobertura(%)	80	20	60	20	50	40	80	70	
Exposición	0	NO	0	NO	NO	N	N	NO	
Inclinación	90	5	20	10	5	10	0	5	
Sustrato	C	C	C	C	C	C	C	C	
Número de especies	5	5	3	3	4	2	3	3	3,5

Característica de asociación:

<i>Fissidens grandifrons</i>	+	2	4	3	1	4	1	2	V
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Características de unidades superiores(*Fontinalis antipyretica*,
Leptodictetella riparii,*Platyhypnidium-Fontinalis*):

<i>Platyhypnidium riparioides</i>	1	1	1	2	3	1	.	3	V
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Compañeras:

<i>Crotoneuron commutatum</i>									
var. <i>commutatum</i>	+	2	.	.	+	.	3	.	III
<i>Philonotis calcarea</i>	.	+	+	II
<i>Apium nodiflorum</i>	.	+	+	.	.	.	.	.	II
<i>Nostoc</i> sp.	.	1	.	.	1	.	.	.	II
<i>Cardamine sylvatica</i>	+	.	.	.	.	.	.	.	I
<i>Plogiomnium rostratum</i>	3	.	.	.	.	.	.	.	I
<i>Bryum pseudotriquetrum</i>	.	.	.	.	.	.	1	.	I

Leyenda: C=Calizas

Tab. 3. — *Fontinaleto-Pachyissidentetum grandifrons* W. Koch 1936.

Sindinámica. — La asociación descrita por KOCH (1936) tiene como características a *Fissidens grandifrons* y *Fontinalis antipyretica*. La comunidad estudiada en Sierra Nevada sólo lleva la primera de estas especies, siendo el cauce del río Aguas Blancas la única localidad conocida para dicha especie. La altitud relativamente baja del nacimiento de este río, así como el efecto del deshielo, permite a sus aguas mantener un alto régimen de caudal además de una esti-

mable pureza y en consecuencia, condiciones idóneas para fijarse una especie tan exigente como *Fissidens grandifrons*; es por tanto la especie pionera que, junto a *Platyhypnidium riparioides*, inicia la colonización de las rocas sumergidas en el cauce del río Aguas Blancas.

Las rocas próximas a los márgenes del río, muestran la sucesión de *Fontinaleto-Pachyfissidentetum grandifrons* hacia la alianza helofítico-basófila *Cratoneurion commutati*, con la que se halla en contacto e incluso solapada la mayoría de las veces.

Sintaxonomía. — La asociación ha sido tradicionalmente incluida en la alianza *Fontinalion antipyreticae* Koch 1936, de la clase *Fontinaletea antipyreticae* v. Hübschmann 1957. Sin embargo, en la reestructuración realizada por HERTEL (1974), la alianza *Fontinalion* no se contempla de forma definitiva, pues la especie directriz de la alianza, *Fontinalis antipyretica*, es realmente indiferente al sustrato; en consecuencia, no es del todo satisfactoria la situación de *Fontinalion* dentro del orden basófilo *Leptodictetalia riparii*. Concluimos de todo ello que es necesaria una posible reconsideración de la estructuración de la clase *Platyhypnidio-Fontinaletea*.

Sincorología. — Se halla generalizada su presencia en los cauces de aguas poco contaminadas de las llanuras calizas europeas. Los datos aportados por P. ALLORGE (1947) nos hacen suponer su existencia en el occidente y centro de la región cántabra, en las montañas calizas del País Vasco y en algunos macizos de Levante y Andalucía. En la provincia Bética, la asociación ha sido localizada en el lecho calizo del río Plines, próximo a Loja (Granada), plenamente desarrollada, aunque con *Fontinalis duriaei* sustituyendo a *Fontinalis antipyretica*, creemos que como asociación vicariante meridional de *Fontinaleto-Pachyfissidentetum grandifrons*.

2. CLASE HYGROHYPNETEA v. Hübschmann 1957

Reúne aquellas comunidades réofilas de carácter alpino. Los estudios de ALLORGE (1925), KRAJINA (1933), HÜBSCHMANN (1957), así como la revisión realizada por GEISSLER (1976), nos han permitido el reconocimiento y estudio de dicha clase en Sierra Nevada, estando representada por las asociaciones *Schistidio-Hygrohypnetum dilatati* Geissler 1976 y *Solenostomo-Hygrohypnetum* Geissler 1976. Ambas asociaciones presentan el comportamiento ecológico que caracteriza a la alianza *Hygrohypnion* Krajina 1933, es decir, una gran adaptación frente a la torrencialidad del agua y acusada psicofilia (los valores medios de la temperatura del agua no llegan a superar los 8°C en verano); las restantes características ecológicas coinciden en su mayor parte con las ya descritas para la clase *Platyhypnidio-Fontinaletea*, puesto que ambas clases se hallan directamente en contacto en Sierra Nevada.

D) ASOCIACION *SCHISTIDIO-HYGROHYPNETUM DILATATI* Geissler 1976

Sinónimo : *Hygrohypnetum dilatati tatrense* Krajina 1933 p.p.

Estructura y composición florística : tab. 4. Origen de los inventarios : tab. 4. N° 1, 2, 3, 16, 17, 18 : 2700, 2760, 2600, 2840, 2680, 2650 m - Río Dílar : 2.9.74. N° 4, 5 : 2370, 2380 m - Campos de Otero : 15.9.74. N° 6 : 3050 m - Laguna de Aguas Verdes : 6.8.75. N° 7, 8, 9, 10 : 2950, 2890, 2870, 2840 m - Río Seco : 6.8.75. N° 11, 19 : 2720, 2700 m - Río Veleta : 26.8.75. N° 12 : 2880 m - Laguna de las Yeguas : 2.8.73. N° 13, 14 : 2880, 2870 m - Río Guarnón : 10.7.76. N° 15 : 2720 m - Río Trevélez : 17.8.76. N° 20, 21 : 2950, 2900 m - Río Lanjarón : 27.7.77. N° 22, 23 : 2450, 2890 m - Río Valdecasillas : 11.8.77.

Sinecología. — La característica fundamental de la asociación es su marcada reofilia, situándose en forma preferente en los rápidos, allí donde la corriente golpea más intensamente. Su carácter psicrófilo también es acentuado, siendo normal su presencia en aguas cuya temperatura no supera un valor medio de 8°C. La asociación es asimismo acidófila, estando siempre sumergida o semi-sumergida en los tramos silíceos comprendidos entre 2400 y 3000 m.

Sinfisionomía. — Comunidad abierta (cobertura media = 65.6%), para una superficie de inventarios media de 21 dm², con un número específico medio de 2,9 (variaciones de 2 a 5). La asociación generalmente presenta un aspecto mixto, pues tiene lugar el contraste entre *Hygrohypnum dilatatum* (*Bryochamaephyta reptantia*) y *Schistidium rivulare* (*Bryochamaephyta caespitosa*), pues si bien las restantes especies de la comunidad (pertenecientes a la clase *Platyhypnidio-Fontinaletea*) poseen un biotipo rastrero, éstas no alcanzan índices muy altos. Este equilibrio fisionómico se altera en la subasociación *Platyhypnidietosum*; es decir, la entrada de *Platyhypnidium riparioides* (*Bryochamaephyta reptantia*) se produce en tal grado, que llega a ocultar la superficie previamente colonizada por las especies pioneras antes mencionadas.

Es asimismo significativa la forma fragmentaria en que suele presentarse la asociación, en consecuencia con la considerable competencia que se establece entre sus especies integrantes.

Sindinámica. — *Hygrohypnum dilatatum* (V) comunica un neto carácter reófilo a la comunidad, estando generalmente asociada a ella *Schistidium rivulare* (III) asimismo adaptada a la torrencialidad del río. Ambas especies se comportan pues, como pioneras en la colonización de rocas con una franca exposición a la corriente. A las anteriores suelen agregarse después, aunque en forma esporádica, las especies que caracterizan a la clase *Platyhypnidio-Fontinaletea*, tales como *Brachythecium rivulare* (II), *Scapania undulata* (II), *Cladophora glomerata* (I), así como *Fontinalis antipyretica* (I) en estaciones más protegidas; en todos los casos va a ser la fuerza del agua, ya que no la temperatura, quien delimite las estaciones a colonizar por las especies de una u otra clase.

Número de inventario	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Superficie(dm ²)	12	10	20	15	40	50	12	20	20	20	12	30	15	20	12	10	15	15	12	25	30	20	40	
Cobertura(%)	30	70	70	60	90	70	40	50	80	90	90	80	40	90	60	90	40	20	90	30	40	80	80	
Exposición	NE	NO	NO	■	N	S	S	S	S	S	S	NE	N	N	SE	NE	N	NO	SO	SO	SO	SE	NO	
Inclinación(°)	45	40	10	60	70	90	50	45	70	30	50	45	30	70	90	70	45	60	20	45	50	70	60	
Sustrato	M	M	M	M	M	M	M	M	M	M	M	M	M	M	■	■	M	M	M	M	M	M	M	
Número de especies	2	3	3	5	4	3	3	2	4	3	3	3	2	3	3	2	3	2	3	3	2	3	2	2,7

Características de asociación y unidades superiores(Schistidio-Hygrohypnetum dilatati,Hygrohypnion dilatati, Hygrohypnetella,Hygrohypnetea):

Hygrohypnum dilatatum	2	3	2	1	2	1	3	3	2	3	2	2	2	2	3	1	2	+	3	3	2	2	4	V
Schistidium rivulare	3	.	.	1	.	.	1	2	2	2	2	2	2	3	1	.	.	.	.	1	.	1	.	III

Diferencial de subasociación(Platyhypnidietosum):

Platyhypnidium riparioides	4	3	3	2	2	3	3	1	II
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Especies de Platyhypnidio-Fontinaletea:

Brachythecium rivulare	.	2	2	+	2	.	.	.	+	.	.	+	.	.	1	II
Scoparia undulata	.	.	.	+	1	2	2	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	II
Fontinalis antipyretica	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Cladophora glomerata	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	I

Compañeras:

Cratoneuron declivens	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Hygrohypnum ochraceum	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Hygrohypnum luridum	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	I
Porella cordaeana	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1

Leyenda: M=Micasquistas

Tab. 4 — *Schistidio-Hygrohypnetum dilatati* Geissler 1976.

La transición hacia las comunidades de *Montio-Cardaminetea* se produce en las rocas próximas a los márgenes del río, siendo generalmente *Brachythecium rivulare* quien sirve de nexo entre las comunidades reófilas y las helófitas.

Finalmente, a medida que el río se va haciendo más caudaloso y como consecuencia de un aumento progresivo en la temperatura del agua, en los pisos inferiores de la sierra se produce la definitiva desaparición de *Hygrohypnum dilatatum*, quedando tan solo *Platyhypnidium riparioides* (II) en poblaciones puras que a veces participan también de la presencia de *Brachythecium rivulare*. Por todo ello proponemos la subasociación *Platyhypnidietosum riparioidis* (*Holotypus* : inventario nº 22, tab. 4) que caracterizaría los tramos a menor altitud, es decir, en el límite del areal ocupado en nuestro territorio por la asociación *Schistidio-Hygrohypnetum dilatati*.

Sintaxonomía. — La asociación es incluida por GEISSLER (1976) en la alianza *Hygrohypnion dilatati* Krajina 1933, orden *Hygrohypnetalia* Krajina 1933, clase *Hygrohypnetea* v. Hübschmann 1957.

Sincorología. — La asociación ha sido localizada al este de los Alpes (ALLORGE, 1925), Trata (KRAJINA, 1933), Alpes Réticos (BRAUN BLANQUET, 1948) y recientemente al oeste de los Alpes (GEISSLER, 1976).

En relación a su distribución peninsular, ALLORGE (1947) hace referencia a una comunidad de *Hygrohypnum dilatatum* e *Hygrohypnum molle*, propia de los pisos montano y alpino de las montañas silíceas de la Península, situándola concretamente por encima de 1600 m en los Pirineos y Cordillera Central, y por encima de 2500 m en Sierra Nevada. CASAS (1975) ha establecido la corología peninsular de *Hygrohypnum dilatatum*, permitiéndonos suponer la existencia de la comunidad en distintos macizos montañosos de la provincias de León, Soria, Lérida, Gerona y la estudiada por nosotros en Sierra Nevada.

E) ASOCIACION SOLENOSTOMO-HYGROHYPNETUM Geissler 1976

Estructura y composición florística : tab. 5. Origen de los inventarios : tab. 5. Nº 1 : 2880 m - Laguna de las Yeguas : 2.9.74. Nº 2, 3, 4 : 2710, 2700, 2500 m - Río Dilar : 4.9.74. Nº 5, 6 : 3000, 2730 m - Río Veleta : 6.8.75. Nº 7 : 2500 m - Río Maitena : 13.7.77.

Sinecología. — Comunidad psicrófila y acidófila que sustituye a *Schistidio-Hygrohypnetum dilatati* en aquellos puntos donde el curso se hace menos caudaloso y torrencial. GEISSLER (1976) diferencia ambas comunidades a partir de la velocidad media de los arroyos, siendo ésta muy superior en *Schistidio-Hygrohypnetum dilatati*; asimismo establece diferencias altitudinales, de forma que *Solenostomo-Hygrohypnetum* corresponde al piso subalpino mientras que *Schistidio-Hygrohypnetum dilatati* lo es del alpino.

En Sierra Nevada también se puede observar una dependencia entre la fuerza del agua y la aparición de una u otra asociación; sin embargo no sucede lo mismo

Número de inventario	1	2	3	4	5	6	7	
Superficie(dm ²)	10	20	15	20	30	10	40	
Cobertura(%)	80	70	90	80	60	50	70	
Exposición	N	NO	NO	N	SE	S	NE	
Inclinación(°)	70	90	40	30	45	10	20	
Sustrato	M	M	M	M	M	M	M	
Número de especies	5	4	4	5	2	4	3	3,8

Características de asociación y de unidades superiores
(*Solenostoma-Hygrohypnetum*, *Hygrohypnion dilatati*, *Hygrohypnetalia*, *Hygrohypnetea*):

<i>Solenostoma cordifolium</i>	1	2	2	1	3	2	+	V
<i>Hygrohypnum dilatatum</i>	2	2	1	2	2	+	3	V

Características de *Platyhypnidio-Fontinaletea*:

<i>Brachythecium rivulare</i>	.	1	2	2	.	.	2	III
<i>Fontinalis antipyretica</i>	1	.	.	+	.	.	.	II
<i>Scapania undulata</i>	1	.	.	.	.	.	.	I
<i>Cladophora glomerata</i>	.	+	.	.	.	.	.	I

Compañeras:

<i>Crotoneuron decipiens</i>	.	.	+	2	.	.	.	II
<i>Hygrohypnum ochraceum</i>	.	.	.	.	.	1	.	I
<i>Hygrohypnum luridum</i>	.	.	.	.	.	1	.	I
<i>Parrella cordaeana</i>	1	.	.	.	.	.	.	I

Leyenda: M=Micasquistos

Tab. 5. — *Solenostoma-Hygrohypnetum* Geissler 1976.

en cuanto a su distribución altitudinal, ya que las aguas del piso oromediterráneo nevadense no reúnen condiciones idóneas para el asentamiento de *Solenostoma-Hygrohypnetum* (con temperaturas muy superiores a la media requerida para la comunidad), de ahí que ambas comunidades coexistan dentro de una franja comprendida entre 2400 y 3000 m.

Sinfisionomía. — Se trata de la comunidad menos abierta de todas las estudiadas (cobertura media = 71%), pues suele formar tapices continuos sobre lechos pedregosos (en menor proporción sobre lechos rocosos); no obstante, al igual que en las asociaciones anteriores la comunidad se caracteriza por ser

fragmentaria, así como por el neto dominio que establecen las especies de biotipo rastrero (*Bryochamaephyta reptantia*), en total ausencia de las de biotipo cespitoso. La superficie de inventarios media es de 20 dm², con número específico medio de 3,8 (variaciones de 2 a 5).

Sindinámica. — El óptimo de la asociación corresponde a los nacimientos de los ríos, es decir, donde el agua conserva la temperatura de deshielo y un régimen no excesivamente torrencial ni caudaloso. En semejantes condiciones, *Hygrohypnum dilatatum* (V) y *Solenostoma cordifolium* (V) actúan como pioneras en la colonización de lechos pedregosos que al adquirir un régimen torrencial más acentuado, evolucionan hacia la asociación *Schistidio-Hygrohypnetum dilatati*. La asociación *Solenostoma-Hygrohypnetum* establece asimismo unas condiciones que favorecen la entrada de especies de *Platyhypnidio-Fontinaletea*, tales como *Brachythecium rivulare* (III), *Fontinalis antipyretica* (II), *Scapania undulata* (I) y *Cladophora glomerata* (I).

También es frecuente en contacto entre la asociación y las comunidades de la clase *Montio-Cardaminea*, puesto que los factores limitantes de éstas no actúan tan intensamente como en asociaciones anteriores.

Sintaxonomía. — Por su distribución y características ecológicas es afín a *Schistidio-Hygrohypnetum dilatati*, por lo que GEISSLER (1976) la incluye asimismo en la alianza *Hygrohypnion dilatati*.

Sincorología. — *Solenostoma cordifolium* es especie nórdica, cuyo areal se extiende a lo largo de Escandinavia, norte de Gran Bretaña e Islandia; también alcanza las partes más elevadas de diferentes cadenas montañosas de Centroeuropa, norte de Italia, Cáucaso, Tránsilvania y Cárpatos. La presencia conjunta de dicha especie con *Hygrohypnum dilatatum*, tan sólo ha sido descrita por GEISSLER (1976) para el oeste de los Alpes suizos, aunque posiblemente también se encuentre la comunidad en algunas de las estaciones antes mencionadas.

De forma semejante a *Hygrohypnum dilatatum*, *Solenostoma cordifolium* posee una distribución peninsular disyunta y limitada a la Sierra de Guadarrama, Pirineos y Sierra Nevada; según MÜLLER (1954-1957), esta última localidad constituye una estación relictica y es en ella donde describimos la asociación por primera vez para la Península Ibérica.

ESQUEMA SINTAXONOMICO DE LAS COMUNIDADES ESTUDIADAS

- Clase *Platyhypnidio-Fontinaletea* Philippi 1956
 - Ord. *Brachythecietalia plumosi* Philippi 1956
 - Al. *Scapanion undulatae* Philippi 1956
 - As. *Scapanietum undulatae* Schwickerath 1944
 - Ord. *Leptodictyetalia riparii* Philippi 1956
 - Al. *Brachythecion rivularis* Hertel 1974
 - As. *Dichodontietum pellucidi* v. Hübschmann 1967

Al. *Fontinalia antipyreticae* W. Koch 1936

As. *Fontinaletto-Pachyfissidentetum grandifrons* W. Koch 1936

Clase *Hygrohypnetea* v. Hübschmann 1957

Ord. *Hygrohypnetalia* Krajina 1933

Al. *Hygrohypnion dilatati* Krajina 1933

As. *Schistidio-Hygrohypnetum dilatati* Geissler 1976

As. *Solenostomo-Hygrohypnetum* Geissler 1976

La lista que a continuación detallamos, corresponde a los musgos y hepáticas que integran las comunidades estudiadas:

Hepáticas

Chiloscyphus polyanthus (L.) Corda var. *rivularis* (Schrad.) Nees

Porella cordaeana (Hüb.) Evans

Scapania undulata (L.) Dum.

Solenostoma cordifolium (Hook.) Steph.

Solenostoma pumilum (With.) K. Mueller

Musgos

Amphidium mougeotii (B.S.G.) Schimp.

Brachythecium rivulare B.S.G.

Bryum pseudotriquetrum (Hedw.) Schwaegr.

Bryum schleicheri Schwaegr.

Cratoneuron commutatum (Hedw.) Roth, var. *commutatum*

Cratoneuron commutatum (Hedw.) Roth var. *irrigatum* (Zett.) Mönk.

Cratoneuron decipiens (De Not.) Loesk.

Dichodontium pellucidum (Hedw.) Schimp. fo. *fagimontanum* C. Jens.

Fissidens grandifrons Brid.

Fontinalis antipyretica L.

Fontinalis hypnoides Hartm. var. *duriaei* (Schimp.) Husnot

Hygrohypnum dilatatum (Wils.) Loesk.

Hygrohypnum luridum (Hedw.) Jenn.

Hygrohypnum ochraceum (Wils.) Loesk.

Philonotis calcarea (B.S.G.) Schimp.

Philonotis seriata Mitt.

Plagiomnium rostratum (Schrad.) Kop.

Platyhypnidium riparioides (Hedw.) Dix.

Schistidium rivulare (Brid.) Podp.

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ERGÄNZUNGEN ZUR CAMPYLOPUS-FLORA VON BRASILIEN

J.-P. FRAHM*

SUMMARY. — *Campylopus luetzelburgii* Herz. ex J.P. Frahm and *C. tortilipilus* J.-P. Frahm are described as new. *C. minarum* Par. has proved to be identical with *C. surinamensis* C. Müll., *C. praealtus* (C. Müll.) Par. with *C. subcuspidatus* (Hamp.) Jaeg., *C. rectisetus* (Hamp.) Jaeg. and *C. discriminatus* (Hamp.) Jaeg. with *C. arctocarpus* (Hornsch.) Mitt., *D. rabenii* Lor. as well as *C. rubricaulis* Lindb. ex C. Müll. with *C. filifolius* (Hornsch.) Mitt. var. *humilis* (Mont.) J.-P. Frahm, *C. brachyphyllus* (C. Müll.) Broth. with *C. savannarum* (C. Müll.) Mitt. and *C. brasiliensis* Broth. nom. nud. with *Atractyllocarpus brasiliensis* (C. Müll.) Williams.

Herbarstudien anlässlich Aufenthalten am Botanischen Museum in Berlin (B) 1979 und am Muséum National d'Histoire Naturelle in Paris (PC) 1980 brachten unter anderem eine Reihe interessanter Belege aus Brasilien zum Vorschein, die bei der Bearbeitung der *Campylopus*-Arten Brasiliens (FRAHM 1979) nicht berücksichtigt worden waren.

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Ausserdem ist die Beschreibung einer neuen Art nach Material, welches D.M. Vital (Sao Paulo) in Brasilien gesammelt hatte, mit aufgenommen.

1. *CAMPYLOPUS LUETZELBURGII* Herz. ex J.-P. Frahm

Unter den *Campylopus*-Proben im Herbar Herzog (JE) sowie im Herbar Thériot (PC) befand sich auch ein mit «*Campylopus luetzelburgii* Herz. n. sp. ad interim» beschrifteter Beleg aus der Serra dos Orgaos in Brasilien. Offenbar hatte Herzog gezögert, diese Art neu zu beschreiben. Ein Vergleich mit den übrigen aus Brasilien beschriebenen Arten (FRAHM 1979) zeigt, dass es sich dabei um eine gewissen anderen sehr ähnliche aber durchaus distinkte eigene Art handelt. Nachdem schliesslich im Herbar des Botanischen Museums Berlin (B) noch ein weiterer Beleg dieser Art, von Dusén in der Serra do Itatiaia gesammelt und als «*Campylopus concolor*» bestimmt, aufgefunden wurde, ist es

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angebracht, diese Art zu veröffentlichen. Dabei soll auf die von Herzog gewählte Bezeichnung *Campylopus luetzelburgii* zurückgegriffen werden. Auf Grund des besseren Herbarmaterials wird jedoch die Probe von Dusén als Holotypus benutzt.

***Campylopus luetzelburgii* Herz. ex J.-P. Frahm**

Plantae steriles, 2-2,5 cm altae, flavescentes, dense foliosae. Folia concava, siccitate appressa, 5 mm longa, ovata, breviter lanceolata, in subulam lanceolatam excurrentes, nervo excurrente, summo apice dentato, basi 3/4 folii occupante, in sectione transversali cellulis ventralibus inanibus, stereidibus nullis. Cellulae laminae basi hyalinae, teneres, rectangulares, 70-90 x 10-14 µm, superiores breviter rectangulares (1:2-3), incrassatae, 13-18(-25) x 9-10 µm (Fig. 1).

Material : Brasilien, Serra do Itatiaia, Agulhas Negras, leg. Dusén 2.7 1902 s.nr. (Holotypus B); Serra dos Orgaos, Morro Assu, auf Granit 2400 m, leg. von Lützelburg Juli 1916 nr. 6793 (Paratypus JE, PC hb. Thériot).

Campylopus luetzelburgii kommt an beiden etwa 200 km Luftlinie auseinanderliegenden Lokalitäten oberhalb der Waldgrenze vor.

Die Art ist an der durch breite, etwas konkav eingebogene Blätter dicht wurmförmige Beblätterung und der hellen, an Frischmaterial wohl gelbgrünen bis weisslichen Beblätterung habituell kenntlich. Anatomisch weist sie Beziehungen zu *Campylopus fragilis* (Brid.) B.S.G. auf, mit der sie die unterhalb der Blattmitte verbreiterte Rippe und die zur Basis hin kontrahierten Blätter gemeinsam hat. *C. luetzelburgii* unterscheidet sich aber von *C. fragilis* durch sehr viel kürzere und breitere Blätter, eine breite Lamina mit 8-12 Zellreihen (*C. fragilis* 3-5) und verlängerte (1:2-3) rechteckige obere Laminazellen (bei *C. fragilis* ± quadratisch), sowie schliesslich dem Rippenquerschnitt ohne Stereiden.

Auffälligerweise existiert im Gebiet noch eine weitere, wie durch den Namen schon angedeutet ebenfalls in die Verwandtschaft von *C. fragilis* gehörende Art, *Campylopus fragiliformis* J.-P. Frahm. Diese Art hat deutlich von *C. fragilis* und *C. luetzelburgii* unterschiedene verlängert ovale obere Laminazellen (Fig. 2). Beide Arten sind aus dem Südostbrasilianischen Bergland bekannt: *C. fragiliformis* aus der Serra do Itatiaia (Typus) und von D.M. Vital neuerdings aus der Serra do Caraca nachgewiesen, *C. luetzelburgii* aus der Serra dos Orgaos und der Serra do Itatiaia. Beiden fehlen die für *C. fragilis* typischen Brutblätter und die durch apikale Kurztriebe pinselförmigen Spitzen der Pflanzen.

2. *CAMPYLOPUS MINARUM* Par. (*Dicranum laxobasis* C. Müll.)

Die von C. MÜLLER 1900 in *Hedwigia* 39 : 252 unter dem Homonym *Dicranum laxobasis* beschriebene Art wurde von PARIS 1904 in *Campylopus minarum* umbenannt. Von dem nicht auffindbaren Holotypus fand sich in PC (Hb. Thériot) eine Doublette, aus der hervorgeht, dass es sich bei dieser Art um *Campylopus surinamensis* C. Müll. handelt. Diese Art war ursprünglich aus den Guianas, dem Amazonastiefland (als *C. marmellensis* und *C. gracilicaulis*), der Karibik und dem Südosten der USA (als *C. gracilicaulis*) bekannt, wo sie auf Sandböden im Tiefland vorkommt, tritt aber auch in Südostbrasilien in

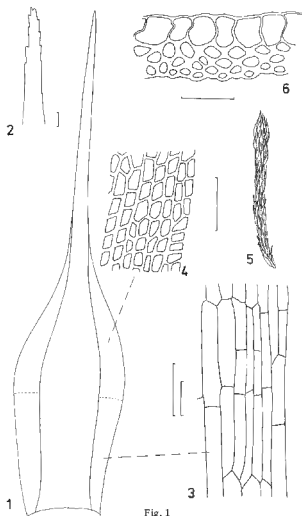
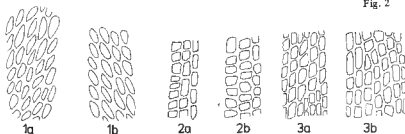


Fig. 1

Fig. 1. — *Campylopus luetzelburgii* Herz. ex J.-P. Frahm, Holotypus. 1 : Blatt aus der Stengelspitze (nat. Grösse 5 mm), 2 : Blattspitze, 3 : Basale Laminazellen, 4 : Obere Laminazellen, 5 : Habitus (nat. Grösse 2 cm) in trockenem Zustand, 6 : Rippenquerschnitt aus der Blattmitte. Massstrich = 50 μ m.

Fig. 2. — Obere Laminazellen von 1. *Campylopus fragiliformis* (a : Vital 7706, b : Isotypus im Hb. des Verfassers), 2. *Campylopus fragilis* (a : Earl Bishop 14.2.1975, b : Vitt 12374, Doubl. aus FLAS bzw. ALTA im Hb. des Verf.), 3. *Campylopus luetzelburgii* (a : Holotypus, b : Paratypus).

Fig. 2



grösseren Höhen bis 1500 m auf, von wo sie schon früher als *Campylopus catumbensis* Broth. beschrieben worden war. Auch der Typus von *Campylopus minarum* stammt hierher (Minas Geraes, Serra Caraca, in rupibus, leg. Ule 3/1892 nr. 1353).

- *Campylopus surinamensis* C. Müll. *Linnaea* 21 : 186, 1848.
- *Campylopus minarum* Par. Ind. Bryol. ed. 2, 1 : 318, 1904 syn. nov. (*Dicranum laxobasis* C. Müll. *Hedwigia* 39 : 252, 1900).

3. *CAMPYLOPUS BRACHYPHYLLULUS* (C. Müll.) Broth.

Im Herbar Thériot (PC) fand sich ein Isotypus dieser nur von der Typuslokalität bekannt gewordenen Art (ein Holotypus in B existiert nicht mehr), der sich als *Campylopus savannarum* erwies :

- *Campylopus savannarum* (C. Müll.) Mitt. J. Linn. Soc., Bot. 12 : 85, 1809 (*Dicranum savannarum* C. Müll. Syn. Musc. 2 : 596, 1851).
 - *Campylopus brachyphyllulus* (C. Müll.) Broth. Nat. Pfl. 1(3) : 332, 1901 (*Dicranum brachyphyllum* C. Müll. *Hedwigia* 39 : 260, 1900) syn. nov.
- Typus** : Brasilien, Minas Geraes, Caraca, ad rupes, Ule 1360 (PC, ISO).

4. *CAMPYLOPUS BRASILIENSIS* Broth. nom. nud.

Das von BROTHERUS in der *Hedwigia* 38 Beibl. 1 : 58, 1899 erwähnte *Campylopus brasiliensis* basiert auf der Nr. 109 der Bryotheca brasiliensis von Ule. Ein Beleg dieser Nummer im Herbar Fleischer (FH) : Brasilien. Rio de Janeiro, Serra do Itatiaia, in paludibus 2300 m, leg. Ule 2/1894, beinhaltet jedoch kein *Campylopus*, sondern ein *Atractylocarpus*. Die gleiche Probe wurde bereits 1898 von C. MÜLLER im Bull. Herb. Boissier 6 : 39 als *Dicranum brasiliense* publiziert und von WILLIAMS 1928 im Bryologist 31 : 110 zu *Atractylocarpus* gestellt. Das Material von *Atractylocarpus brasiliensis* gleicht in jeder Hinsicht Herbarbelegen von *A. longisetus* (Hook.) Bartr., sodass *A. brasiliensis* mutmasslich mit *A. longisetus* identisch ist und dieses eine weitere, sowohl in den Anden als auch im südostbrasilianischen Bergland vorkommende Art wäre.

- *Atractylocarpus brasiliensis* (C. Müll.) Williams Bryologist 31 : 110, 1928 (*Dicranum brasiliense* C. Müll. Bull. Herb. Boissier 6 : 39, 1898).
- *Campylopus brasiliensis* Broth. *Hedwigia* 38 Beibl. 1 : 58, 1899 nom. nud.

5. *DICRANUM RABENII* Lor. und *CAMPYLOPUS RUBRICAULIS* Lindb. in C. Müll.

Eine Überprüfung der Typen von *Dicranum rabenii* Lor. (Brasilia, com. Raben, B) und *Campylopus rubricaulis* Lindb. in C. Müll. (Brasilien, Caldas, leg. Lindberg 18.9.1894, B) ergab, dass es sich bei beiden Arten um *Campylopus filifolius* var. *humilis* handelt, einer in Südostbrasilien und im gesamten Areal

von *C. filifolius* durch das nördliche Südamerika bis nach Mittelamerika häufigen Varietät im Bereich der Bergregenwälder.

- *Campylopus filifolius* (Hornsch.) Mitt. J. Linn. Soc., Bot. 12 : 76, 1869 (*Dicranum filifolium* Hornsch. Fl. Bras. 1 : 12, 1840) var. *humilis* (Mont.) J.-P. Frahm Nova Hedwigia 29 : 249, 1978 (*Campylopus humilis* Mont. Ann. Sci. Nat. Bot. sér. 3, 4 : 110, 1845).
- *Dicranum rabenii* Lor. Moosstudien : 158, 1864, syn. nov.
- *Campylopus rubricaulis* Lindb. in C. Müll. Gen. Musc. Fr. : 169, 1900 nom. nud., syn. nov.

6. *CAMPYLOPUS SUBCUSPIDATUS* (Hamp.) Jaeg.

Bei dem Typus dieser nur von der Typuslokalität (Brasilien, Pic de la Tijuca, leg. Glaziou 19.4.1873 nr. 7096, PC) bekannt gewordenen und von HAMPE (1870) beschriebenen Art handelt es sich um das, was 30 Jahre später als *Campylopus praealtus* (C. Müll.) Par. beschrieben wurde. HAMPE gibt zur Unterscheidung dieser Art an : «vero *D.(icrano) cuspidato affinis, sed caule interrupte tomentoso, laxe foliato, lutescente; splendente, foliis patentibus, nervo laxiore, triplo latiore omnini diversa.*» In der Tat ähneln sich *C. cuspidatus* und *subcuspidatus* (= *praealtus*) habituell bezüglich der Grösse und dem goldgelben Glanz der Pflanzen sehr. Wie von HAMPE angegeben, ist bei *C. subcuspidatus* im Gegensatz zu *C. cuspidatus* die Rippe wesentlich breiter (3/4 statt 1/3 der Blattbreite am Blattgrund) und die Blätter stehen bei *C. subcuspidatus* weiter ab. Ausserdem besitzt *C. cuspidatus* auffällige kollenchymatisch verdickte Blattflügelzellen. Bei *C. subcuspidatus* ist ferner der basale Blattrand von einem Saum aus dünnwandigen schmalen Zellen gesäumt, welcher bei *C. cuspidatus* fehlt. Auch das Zellnetz ist in der oberen Hälfte der Lamina unterschiedlich, und zwar verlängert, verdickt und deutlich getüpfelt bei *C. cuspidatus* und verlängert oval, dickwandig, aber nicht deutlich getüpfelt bei *C. subcuspidatus*. Schliesslich besitzt *C. cuspidatus* vielfach eine hyaline Haarspitze.

Aus Prioritätsgründen muss daher die wohlbekannte Bezeichnung *C. praealtus* dem älteren Namen *C. subcuspidatus* weichen.

- *Campylopus subcuspidatus* (Hamp.) Jaeg. Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1870-71 : 441, 1872 (*Dicranum subcuspidatum* Hamp. Vidensk. Meddel. Dansk Naturhist. Foren. Kjöbenhavn 1870 : 273).
- *Campylopus praealtus* (C. Müll.) Par. Ind. Bryol. : 96, 1900, syn. nov. (*Dicranum praealtum* C. Müll. Hedwigia 37 : 227, 1898).

Campylopus subcuspidatus ist unter der jüngeren Bezeichnung *C. praealtus* von Puerto Rico, Venezuela, Surinam, Honduras und Brasilien bekannt und nach einem bislang unpubliziertem Fund auch in Costa Rica nachgewiesen.

7. *CAMPYLOPUS DISCRIMINATUS* (Hamp.) Jaeg.

Eine Überprüfung der Syntypen von *Campylopus discriminatus* (Glaziou

7434, 7096, PC) und des Lectotyps (Glaziou 7147, H-BR) ergab, dass keine artspezifischen Unterschiede zu *Campylopus arctocarpus* (Hornsch.) Mitt. vorliegen. Interessanterweise stellte sich bei Durchsicht der Glaziou-Kollektionen in Paris heraus, dass Hampe als Bearbeiter dieser Aufsammlungen *C. filifolius* (Hornsch.) Mitt. für *C. arctocarpus* hielt. Dementsprechend hat er die Aufsammlungen des eigentlichen *C. arctocarpus* als *C. discriminatus* neu beschrieben. Ausser von Hampe wurde die Art nur noch von BROOTHERUS (1895, 1926) aus Brasilien angegeben.

- *Campylopus arctocarpus* (Hornsch.) Mitt. *J. Linn. Soc., Bot.* 12 : 87, 1869 (*Dicranum arctocarpum* Hornsch. *Fl. Bras.* 1(2) : 12, 1840).
- *Campylopus discriminatus* (Hamp.) Jaeg. *Ber. Thätigk. St. Gallischen Naturwiss. Ges.* 1877-78 : 497, 1880 syn. nov. (*Dicranum discriminatum* Hamp. *Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn* 1878 : 254).

8. *CAMPYLOPUS TORTILIPILUS* J.-P. Frahm spec. nov.

Unter Aufsammlungen, die ich von D.M. Vital (Sao Paulo) bekam, befand sich u.a. eine Probe eines haartragenden *Campylopus* mit so eindeutig neuen Merkmalsausprägungen, dass die Art hier, obwohl nur von einer Stelle bekannt, als neue Art beschrieben werden soll. Kennzeichnend für diese Art sind die auffällig gelbgrünen niedrigen Rasen, Blätter, die in ein relativ langes (1/3 der Blattlänge) gezähntes und wellig verbogenes hyalines Glashaar enden und ein Rippenquerschnitt mit ventralen Substereiden. Abgesehen von den verbogenen Glashaaren und der hellen Färbung ist *C. tortilipilus* einem *C. pilifer* Brid. ähnlich, weicht aber durch verlängert ovale und in den Ecken verdickte Laminazellen, einen gesägten oberen Blattrand und dickwandige basale Laminazellen sehr deutlich von dieser Art ab.

Campylopus tortilipilus J.-P. Frahm spec. nov.

Plantae steriles, 5-10 mm altae, luteo-flavescentes, laxae caespitosae. Folia 3 mm longa, e basi contracto lanceolata, in pilum hyalinum longum serratum et tortuosum apiculata. Costa dimidiam folii occupante, in sectione transversali substereidibus ventralibus et stereidibus dorsalibus. Cellulae laminae in parte superiore ovatae-elongatae, incrassatae, 18-35 x 5-9 µm (1:4-5), in parte inferiore rectangulares, incrassatae, 20-40 x 15 µm, ad marginem subquadratae.

Material : In partial shade, on soil, in a cerrado vegetation, 10°33'S, 45°11'W, Municipio de Corrente, Piaui State, leg. D.M. Vital 28.5.1978 nr. 8232 (Holotypus SP, Isotypus im Herbar des Verfassers).

Der Nordosten Brasiliens ist bryologisch nur wenig bekannt und durchforscht, sodass anzunehmen ist, dass *C. tortilipilus* dort noch an weiteren Stellen vorkommt. Ebenfalls nur aus diesem Gebiet Brasiliens ist *Campylopus gardneri* (C. Müll.) Mitt. bekannt, was eine gewisse Eigenständigkeit dieses Florengebietes ausdrückt.

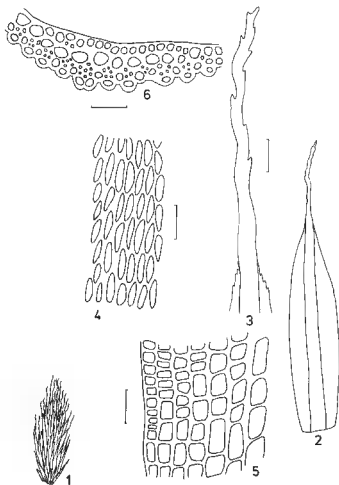


Fig. 3. — *Campylopus tortilipilus* J.-P. Frahm spec. nov. 1 : Pflanze, Originalgrösse 5 mm, 2 : Blatt, Originalgrösse 3 mm incl. Glashaar, 3 : Blattspitze, 4 : Zellnetz der oberen Lamina, 5 : Zellnetz des Blattgrundes, 6 : Rippenquerschnitt. Massstrich = 50 μ m.

9. *CAMPYLOPUS RECTISETUS* (Hamp.) Jaeg.

Bei dem Typus dieser Art (Brasilien, Rio de Janeiro, Glaziou 6364, PC) handelt es sich um *C. arctocarpus* (Hornsch.) Mitt., einer von Hampe verkannten Art (vgl. Nummer 7 dieses Beitrages).

— *Campylopus arctocarpus* (Hornsch.) Mitt. *J. Linn. Soc., Bot.* 12 : 87, 1869 (*Dicranum arctocarpum* Hornsch. *Fl. Bras.* 1(2) : 12, 1840).

- *Campylopus rectisetus* (Hamp.) Jaeg. Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1877-78 : 385, 1880 (*Dicranum rectisetum* Hamp. Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1875 : 137).

Campylopus rectisetus ist später nur noch von BROTHERUS (1895) aus Minas Geraes angegeben worden; auch bei diesen Belegen (H-BR) handelt es sich um *C. arctocarpus*.

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SYNOPSIS OF RHIZOGONIACEAE BROTH. IN MALAYA¹

M.G. MANUEL*

ABSTRACT. — *Pyrrhobryum* Mitt. *emend.* Manuel has three species (*P. spiniforme* (Hedw.) Mitt., *P. longiflorum* Mitt., & *P. latifolium* (Bosch. & Lac.) Mitt.) in Malaya while *Rhizogonium* Brid. has only a single species, *R. novae-hollandiae* (Brid.) Brid. A key to the two genera and four species is provided along with critical notes on each species, and illustrations.

INTRODUCTION

Of the seven genera currently recognized in Rhizogoniaceae (BROTHERUS 1924, CROSBY 1979, NORRIS & ROBINSON 1979), two are present in Malaya (Peninsular Malaysia and the Republic of Singapore). *Pyrrhobryum* Mitt. has three species whereas *Rhizogonium* Brid. has only a single species. The recent discovery of *P. longiflorum* Mitt. in Malaya (MANUEL 1980a) prompted a critical reexamination of previous collections of Rhizogoniaceae in Malaya. The results of that reexamination are reported herein.

METHODS AND MATERIALS

This study is based on about 120 specimens in the herbaria of KLU, SING, and TNS. All observations, measurements, and drawings (except habit of gametophores) were made from specimens mounted in Hoyer's Solution (ANDERSON 1954).

SYSTEMATIC TREATMENT

Key to the Genera and Species of Rhizogoniaceae in Malaya

1. Leaves distichous, margins unistratose with single teeth, costa smooth dorsally; capsule almost without ■ neck. 1. *RHIZOGONIUM*
1. Leaves not distichous, margins multistratose with double teeth, costa toothed dorsally; capsule with distinct neck. 2. *PYRRHOBRYUM* 2.

1. I thank Dr. B.C. Stone (KLU), for reading the manuscript, Dr. N.G. Miller (GH) and Dr. A. Touw (L) for help with the literature, and the curators of SING and TNS. Financial assistance from Universiti Malaya (Vote F 128/79 & 110/80) is acknowledged.

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2. Medial stem leaves narrowed to insertion, 3.0-4.0(-5.0) mm long; inner perichaetial bracts over 5.0-8.0 mm long, filiform acuminate. 3
2. Medial stem leaves not narrowed to insertion (lower and upper leaves occasionally slightly narrowed to insertion), 4.0-6.5 mm long; inner perichaetial bracts 2.0-3.5(-4.1) mm long, acuminate to filiform acuminate. 2a. *P. spiniforme*
3. Medial stem leaves narrowly elliptic-lanceolate, apices long acuminate. 2b. *P. longiflorum*
3. Medial stem leaves widely elliptic-lanceolate, apices acuminate. 2c. *P. latifolium*

1. RHIZOGONIUM Brid., Bryol. Univ. 2 : 644. 1827.

Note. — The genus *Rhizogonium* Brid. s.s. (MANUEL 1980b) is pantropic in distribution and is represented by eight species within Malesia. One species, *R. novae-hollandiae* (Brid.) Brid. occurs in Malaya.

- 1a. *Rhizogonium novae-hollandiae* (Brid.) Brid., Bryol. Univ. 2 : 664. 2f. 1-3. 1827. — *Fissidens novae-hollandiae* Brid., Bot. Zeitung (Regensburg) 1 : 212, 234. 1802.**

Distribution. — Malaya (Pahang), Borneo (Sabah), Australia, Tasmania, New Zealand, Juan Fernandez, and Patagonia.

Note. — *Rhizogonium novae-hollandiae* (Brid.) Brid. is an antipodal species with disjunct populations in Malesia at high elevations. In Malaya the species has been found only in the montane forests between 1440 and 2100 m while in Borneo it has been reported from Mt Kinabalu (DIXON 1935).

Specimens examined. — MALAYSIA. PAHANG : Cameron Highlands, Brinchang, ca 5000 ft., Clear 1329 (KLU). Cameron Highlands, Tanah Rata, 4800 ft., Henderson 17829 (SING). Gunung Tahan, 5500-7000 ft., Nur 7976 (SING). Gunung Tahan, ± 5500 ft., Holttum 20926a (SING). SABAH (Borneo) : Kamborangah ridge forest, 7200 ft., Holttum 25655 (SING).

2. PYRRHOBRYUM Mitt. emend. Manuel, J. Linn. Soc., Bot. 10 : 174. 1868.

Note. — For a discussion of the classification of *Rhizogonium* and *Pyrrhobryum* see MANUEL (1980b).

- 2a. *Pyrrhobryum spiniforme* (Hedw.) Mitt., J. Linn. Soc., Bot. 10 : 174. 1869. — *Hypnum spiniforme* Hedw., Spec. Musc. : 236. 1801. — *Rhizogonium spiniforme* (Hedw.) Bruch in KRAUSS, Flora 29 : 134. 1846.**

Distribution. — Malaya (Johor, Kedah, Kelantan, Pahang, Penang & Selangor; Singapore); pantropic.

Notes. — 1. NOGUCHI (1973) reported *Rhizogonium badakense* Fleisch. (*Pyrrhobryum spiniforme* var. *badakense* (Fleisch.) Manuel) from the state of

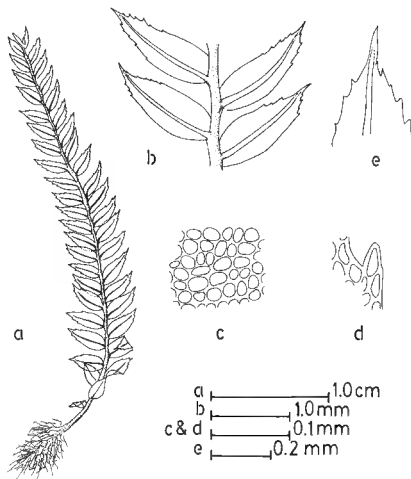


Fig. 1. — *Rhizogonium novae-hollandiae* (Brid.) Brid. a. Gametophore, b. Leaves, c. Medial leaf cells, d. Marginal tooth, e. Leaf apex.

Pahang. The specimen upon which he based his report (Inoue 10797, 10904, 16223 & 16371) are *P. spiniforme* var. *spiniforme*.

2. Within the local populations of *P. spiniforme* there are some morphological «entities» that are more or less distinct and occur in more than one locality. Whether these «entities» are the result of a similar phenotypic response to similar microenvironments or the result of genotypic differences, I do not know and hence have not given them formal recognition under the ICBN. Further investigations are in progress.

— ENTITY A. Gametophore small; medial stem leaves short, narrow, and plane. (Manuel 2419, Nur 9191, Henderson 19640, & JSG 248; vide specim. exam.).

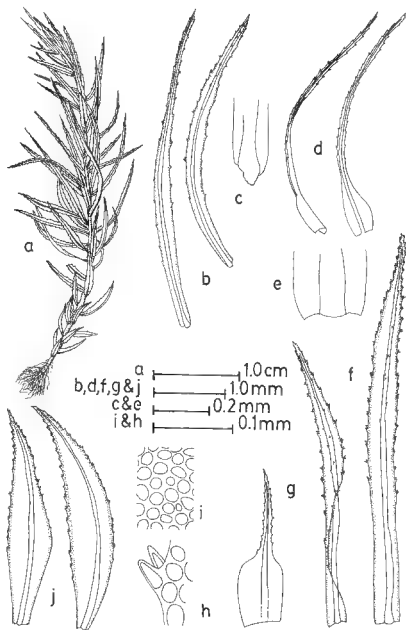


Fig. 2. — *Pyrrhobryum*. *P. longiflorum* Mitt. a. Gametophore, b. Medial stem leaves, c. Leaf base, d. Inner perichaetial bracts. *P. spiniforme* (Hedw.) Mitt. e. Leaf base, f. Medial stem leaves, g. Inner perichaetial bract. *P. latifolium* (Bosch. & Lac.) Mitt. i. Medial leaf cells, h. Marginal tooth, j. Medial stem leaves.

- ENTITY B. Gametophore robust; medial stem leaves long, broad, and slightly keeled (Holttum 10697 & 18068, Ridley 106 & 526, & Curtis 5; vide specim. exam.).

The perichaetial bracts of the above two «entities» are well within the normal range of variation for *P. spiniforme* var. *spiniforme* (INOUE & IWATSUKI 1976).

Specimens examined. — SINGAPORE. Chan Chu Kang, J.G.G. Gamble 248 (SING.). Chan Chu Kang, Ridley 113 (SING.). Bukit Timah, Nur 9191 (SING.). Kranji, Ridley 106 (SING.). Brittan Peak, Luerek 675 (SING.). Bukit Tuish, Ridley 250 (SING.). MALAYSIA, JOHOR : Gunong Belumut, 3000 ft., Holttum 10698 (SING.) & 10697 (SING.). Gunong Panti, 1600 ft., Holttum 18068 (SING.). KEDAH : Gunong Raya, Harift & Nur 7144 (SING.). Langkawi, Curtis, Sept. 1890 (SING.). KELANTAN : Gunong Sitong, 2600 ft., Nur 12236 (SING.). Sungei Ketei, Henderson 19640 (SING.). PAHANG : Fraser Hill : 4000-4370 ft., Burkill & Holttum 8468 (SING.) & 8784 (SING.); 4000 ft., Ridley 287 (SING.); Kalong 22430 (SING.); Burkill 1166 (SING.), 2061 (SING.), & 2114 (SING.); Manuel 2778 (KLU); Poore s.n. (KLU); Johnson B1037 (KLU); Poore 48 (KLU). Cameron Highlands : Clear 1195 (KLU) & 1339 (KLU); Tanah Rata, 5200 ft., Inoue 10059 (TNS), 10060 (TNS) & 10061 (TNS); Brinchang, 600 ft., Inoue 10797 (TNS) & 10904 (TNS), Poore 116 (KLU); Near Robinson's Falls, 5000 ft., Inoue 10753 (TNS), 10787 (TNS), & 10788 (TNS); around Robinson's Water Fall, Inoue 16223 (TNS) & 16371 (TNS), Henderson 11722 (SING.). Gunong Tahan, 5500 ft., Holttum 20926 (SING.). Tahan River, Ridley, 1841 (SING.). Gunong Ber (icalica?), Nur 121 (SING.). Telom, Nur 1900 (SING.), 94 (SING.), 142 (SING.). Gua Kajang, 3383 ft., Henderson 18271 (SING.). Pulau Tioman, Gunong Kajang, 2000 ft., D.W. Lee, 24 May 1974 (KLU). Genting Sempah, 3000 ft., Stone 9572a (KLU). PERAK : Taiping Hills, 4500, Anderson 312 (SING.) & 314b (SING.). Maxwell Hill, Ridley, 1893 (SING.). Jor Tapah, Haniff 16173 (SING.). Temengoh, Ridley 182 (SING.). Lower Camp, Gunong Batu Puteh, Wray 1047 (SING.). Bird's Hill, 3800 ft., Burkill 12603 (SING.). PENANG : Penang Hill : 2000 ft., Johnson, May 1966 (KLU); Ridley 526 (SING.). Tiger Hill, 2100 ft., W. (Suikie?) 3315 (SING.). Richmond's Pool, W. (Suikie?) 2607 (SING.); Haniff 15003 (SING.) & 15020 (SING.). Government Hill, Curtis 5 (SING.). SELANGOR : Genting Bidai, Ridley 407 (SING.). Near 21 mile mark on old Genting Highland Rd., ca 1000 m, Manuel 2419 (KLU). Bukit Hitam s. leg., 1896 (SING.).

- 2b. *Pyrrhobryum longiflorum* Mitt., J. Linn. Soc., Bot. 10 : 174. 1868. — *Rhizogonium longiflorum* (Mitt.) Jaeg., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1873-74 : 223. 1875 (Ad. 1: 685).

Distribution. — Malaya (Johore, Negri Sembilan, & Pahang) and Borneo (Sabah & Sarawak).

Notes. — 1. IWATSUKI (1969 & 1972) stated that *Pyrrhobryum longiflorum* Mitt. (as *Rhizogonium longiflorum* (Mitt.) Jaeg.) is a lowland species (below 330 m) in northern Borneo and is clearly separated from *P. spiniforme* (Hedw.) Mitt. (600-1500 m elev.) in elevational distribution. From the data on herbarium

labels, the same elevational distribution seems to occur in Malaya except that *P. spiniforme* reaches 1650 m on Gunong Tahan.

2. The species is characterized by a) medial stem leaves narrowed at insertion, b) long, filiform acuminate perichaetial bracts, and c) dioicous sexuality (IWATSUKI 1969).

Specimens examined. — MALAYSIA. JOHORE : Gunong Kambak, ca. 700 ft., on fallen tree, Holttum 9459 (SING). Mersing, Clear 1362 (KLU) & 1363 (KLU). NEGRI SEMBILAN : Selaru, F.R., on fallen tree, Holttum 9745 (SING). PAHANG : Taman Negara : Lata Berkoh area on Sungai Tahan, 200-300 ft., Manuel 2566 (KLU), 2568a (KLU); Bukit Indah, ca. 250 ft., Manuel 2663 (KLU); & Bukit Tersek Trail ca. 200-1000 ft., Manuel 2535 (KLU). Tahan River, Ridley, 1893 (SING).

2c. *Pyrrhobryum latifolium* (Bosch & Lac.) Mitt., *J. Linn. Soc., Bot.* 10 : 175. 1868. — *Rhizogonium latifolium* Bosch & Lac., *Bryol. Jav.* 2 : 2. 133. 1861.

Distribution. — Malaya (Johor, Perak, & Singapore), Banka, Borneo (Sabah & Kalimantan Barat), Philippines, and New Guinea.

Note. — *Pyrrhobryum latifolium* (Bosch & Lac.) Mitt. and *P. longiflorum* are separated by differences in the apices and the shape of the medial stem leaves. I have not seen any overlap in the shape of the medial stem leaves of the two species, but the apical and basal stem leaves of *P. longiflorum* sometimes resemble the medial stem leaves of *P. latifolium*.

Specimens examined. — SINGAPORE : Jungle Fall Valley, on rock, L.H. Merton, 19 May 1960 (KLU). Bukit Timah, Ridley 652A (SING). Rock Path, Bukit Timah Forest Reserve, Sinclair 7355 (SING). MALAYSIA. JOHOR : Sungei Semagot Kanan, 30 mile mark Kota Tinggi-Mersing Rd., Sinclair 10757 (SING). PERAK : Bidor Road (Tapah?), s.n. 154 (SING).

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REGENERATION AND GEMMA DEVELOPMENT IN *HYOPHILA CRENULATA* C. MUELL. EX DUS.

S.O. OLARINMOYE*

ABSTRACT. — Further culture studies and field observations have proved that gemmae of *Hyophila crenulata* C. Muell. ex Dus. are protonematal and not rhizoidal. Leaves of the moss readily regenerate and the protonemal strands which produced copious gemmae have supplied the required information on the origin of gemmae in *Hyophila*. Some of the gemmae, while still attached to gemmifers, germinated to produce more gemmae in culture. Gemmae production is related to humidity; higher humidity resulting in more abundant gemmae production. Flooding of shoots of *H. crenulata* resulted in abundant production of basal protonematal gemmae. Gemmae production in the moss, must have contributed significantly to its extensive cover in its ecological niches, usually gutters, drainage areas etc. and to its ecological success in such areas.

INTRODUCTION

Abundant production of gemmae has been reported in *Hyophila crenulata* (OLARINMOYE 1981). Occurrence of gemmae has also been reported in *H. tortula* (ANDREWS & REDFEARN 1965) and in *H. propagulifera* (NEHIRA 1969). However, the exact origin, protonemal or rhizoidal, of these gemmae, has not been established.

In nature, gemmae of *H. crenulata* are produced both on long tufts of gemmifers arising from the apices of shoots and in grapefashion bunches on exposed bases of the shoots.

In the present work, the origin of the gemmifers and their gemmae, as well as the effects of moisture on the production of gemmae has been elucidated. The possible role of gemmae in the ecological success of the moss, *Hyophila*, was discussed.

MATERIALS AND METHODS

Hyophila crenulata was collected from the almost pure stands in the wet gutter in front of the author's laboratory at Ibadan University. The material

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was divided into suitable portions and each portion was put in a large evaporating dish and kept moist as required during the period of use.

The shoots used in regeneration experiments were thoroughly washed in running tap water and later surface-sterilized in chlorex for 3-4 minutes before being finally washed in several changes of sterile distilled water.

15 detached leaves were plated on pads of two No. 3 Whatman filter papers, moistened with distilled water, in 10 cm plastic Petri dishes. The culture was maintained in a 16h-8h light cycle at a light intensity of 1000 lux and a temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$, at the culture level. Each plate was duplicated. The cultures were observed daily for regeneration, which was recorded as percentage regeneration per day. Gemmae production, and their positions were also observed.

In another set-up, detached leaves were cut into two approximately equal halves and plated side by side under a similar set-up as whole leaves. 25 pieces of each half were plated. Other detached leaves were fragmented into tiny bits and plated. Not less than 45 fragments were plated in each Petri dish.

In a final set-up, 20 whole shoots of *H. crenulata* were introduced into a Petri dish and then flooded with distilled water. The covered Petri dish was subjected to the same treatment as earlier described. All experiments were duplicated.

RESULT

In all the set-ups, regeneration commenced on the 3rd day and reached the peak on the 8th day (Tab. 1). Regeneration occurred in all treatments, though lower in the detached whole leaf treatment in the early days. A maximum of less than 100% was recorded in the mutilated leaf segments because a number of fragments died before regeneration started (Tab. 1). Regeneration occurred only on the cut ends in cut and fragmented pieces, while in whole leaves the bulk of regenerants arose at the base, and occasionally on the midrib.

Tab. 1. — Regeneration in leaves of *Hyophila crenulata*

Treatment	% regeneration		
	Day 3	Day 5	Day 8
Whole leaf	35 ± 2.0	80 ± 2.5	100
Upper half of leaf	40 ± 1.5	90 ± 1.0	95 ± 1.5
Lower half of leaf	45 ± 3.5	88 ± 1.5	97 ± 2.0
Mutilated leaf	60 ± 1.0	75 ± 2.0	85 ± 0.5

In all cultures where regeneration was recorded, gemmae, similar to those usually found in nature, were produced (Tab. 2). They occurred at different stages of development. These gemmae were borne on gemmifers produced on protonemal strands (Pl. 1, 1). In some cases the gemmae were produced in

Tab. 2. - Gemma production on regenerants from leaves of *Hyophila crenulata*.

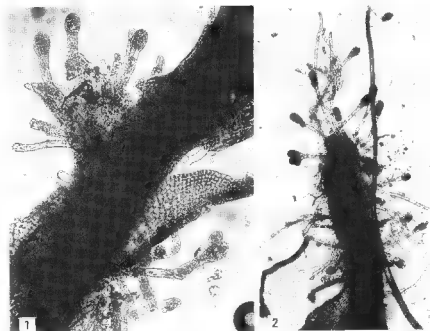
% gemma production was assessed from the number of regenerating leaves or leaf fragments producing gemmae in a culture dish.

Treatment	Whole leaf	Upper half	Lower half	Mutilated leaf
% gemma production	100	100	100	100

bunches on the protonemal strands. The quantity of gemmae produced was a function of the ramification of protonemal strands in the cultures. Gemmifers and gemmae however, were not produced on all protonemal strands.

When whole shoots were flooded with water, gemmifers and gemmae were produced both on the young leaves at the apices and at the base of the shoots.

Gemmae were borne on long tufts of gemmifers when they occur on leaves at the apices while they were either in grape-like bunches or on a few strands of protonemata when at the base (Pl. 1, 2).



Pl. 1. - 1 : Bunches of protonemal gemmae from the leaf. 2 : Basal protonemal gemmae.

Some gemmae produced on regenerating leaves germinated and produced other gemmae, while still attached to the original gemmifer (Fig.).

DISCUSSION



Fig. — Secondary gemma production from a primary one. PG : primary gemma. SG : secondary gemma. T : tymema.

Leaves of *H. crenulata* regenerated readily in culture. The protonemal strands produced the gemmifers on which the gemmae were borne. Production of gemmae on long gemmifers on leaves and in large bunches at the base of whole shoots has been confirmed in later collections from different habitats. It has been found that *H. crenulata* collected on cement slabs and other places not regularly inundated, produced apical gemmae mainly. Those in gutters with regular inundation produced both apical and basal gemmae. This apparently occurs because the base of shoots are normally more exposed in those growing in gutters than in those on concrete slabs.

The observed production of secondary gemmae on gemmifers produced from primary gemmae is similar to that observed on *Schistostega pennata* (Hedw.) Web. & Mohr (EDWARDS 1978).

The ready production of regenerants and the abundant production of gemmifers and gemmae on them must be of tremendous ecological importance to the moss, *H. crenulata*. While it would surely serve as an effective means of spread, it also confers to the moss competitive advantage and thus enhances its survival.

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CONTRIBUTION A L'ÉTUDE DES LICHENS DU KIVU (ZAÏRE), DU RWANDA ET DU BURUNDI

VI. Les genres COCCOCARPIA Pers. et LOBARIA (Schreb.) Hoffm.

E. SÉRUSIAUX*

RÉSUMÉ. — Le genre *Coccocarpia* est représenté dans l'est de l'Afrique centrale par trois espèces : *C. erythroxyli* (Spreng.) Swinscow & Krog, répandu dans les milieux de forêts et savanes boisées jusqu'à 2100 m d'altitude, *C. palmicola* (Spreng.) Arvidss. & D. Gall., trouvant son optimum dans la forêt de montagne jusqu'à 2450 m, et *C. pellita* (Ach.) Müll. Arg., connu seulement dans la chaîne des Birunga vers 2400 m. Le genre *Lobaria* compte trois espèces : *L. pulmonaria* (L.) Hoffm., épiphyte rare localisé aux stations humides de la forêt de montagne entre 2000 et 2700 m, *L. retigera* (Bory) Trev., fréquent à l'état épiphytique et terricole dans des milieux analogues entre 1900 et 2500 m, et *Lobaria sublaevis* (Nyl.) Yoshim. dont c'est la première mention en Afrique continentale.

ABSTRACT. — Revision of the genera *Coccocarpia* and *Lobaria* in Kivu (Zaire), Rwanda and Burundi. The first one is represented by three species : *C. erythroxyli* (Spreng.) Swinscow & Krog widespread in forests and wooded-savannas up to 2100 m elevation, *C. palmicola* (Spreng.) Arvidss. & D. Gall. mostly developed in montane forests up to 2450 m elevation and *C. pellita* (Ach.) Müll. Arg. restricted to the Birunga volcanoes around 2400 m. Three *Lobaria* species are present : *L. pulmonaria* (L.) Hoffm. rare epiphyte confined to humid stations inside montane forests from 2000 to 2700 m, *L. retigera* (Bory) Trev. epiphyte or terricolous in the same biotopes between 1900 and 2500 m but much more abundant and *Lobaria sublaevis* (Nyl.) Yoshim. which is mentioned for the first time in continental Africa.

Nous poursuivons ici la série de travaux consacrés aux lichens du Kivu (Zaire), du Rwanda et du Burundi, par l'étude de deux genres (*Coccocarpia* et *Lobaria*) modestement représentés dans cette partie de l'Afrique. La comparaison est cependant instructive avec d'autres régions intertropicales (Amérique centrale, Indonésie et Asie du S-E). De plus, les espèces de ces deux genres présentes dans la région sont bien connues taxonomiquement. On se reportera donc au remarquable travail de YOSHIMURA (1971) pour de plus amples détails sur les *Lobaria* et à ceux de SWINSCOW & KROG (1976) et de ARVIDSSON & GAL-

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LOWAY (1979) pour les *Coccocarpia*. Sauf indication contraire, le matériel est conservé à LG, mais des doubles doivent être distribués dans plusieurs herbaria.

COCCOCARPIA Persoon

In C. GAUDICHAUD, Voyage autour du monde entrepris par ordre du Roi (...) exécuté sur les corvettes de S.M. L'Uranie et la Physicienne pendant les années 1817, 1818, 1819 et 1820 par M. Louis de Freycinet. Paris, Pillet Aîné, 1826. Bot. : 206¹.

Esèce-type. — *Coccocarpia molyhdea* Pers., loc. cit. : 206 (lectotyp. : voir R. SANTESSON, *Sym. Bot. Upsal.* 12 (1) : 414, 1952, sub «*C. molybdina* Pers.»).

COCCOCARPIA ERYTHROXYLI (Spreng.) Swinscow & Krog
Norw. J. Bot. 23 : 256, 1976 (comme «*erythroxyli*»).

Basionyme. — *Lecidea erythroxyli* Spreng. *Kunigl. Vetensk. - Academ. Nya Handl.* 1 : 47, 1820.

Type. — Guadeloupe, in cortice *Erythroxyli squamati*, Martius 1818 (lectotype, TO).

= *Coccocarpia parmelioidea* (Hook.) Curtis (pour plus de détails sur la synonymie, voir SWINSCOW & KROG 1976 : 256).

ZAÏRE : District forestier central : Irangi, station de recherches de l'I.R.S.A.C., près de la rivière Luhoho, env. 850 m, sur racines-échasses moussues d'*Uapaca* en lisière de la forêt à la limite de la clairière de la station, Lambinon 72/08 (fertile).

RWANDA : District afro-montagnard : Forêt de Rugege, lieu-dit Ruwankuba, 1950 m, forêt de vallée à *Syzygium rowlandii*, sur les lianes et les rameaux ligneux couverts de bryophytes dans le sous-bois, vers 1-2 m de haut, Lambinon 71/1076 (fertile). — Ibid., vers le km 107 de la route Butare-Cyangugu (non loin de Garamba), env. 1900 m, sur branche de *Ficalhoa laurifolia*, forêt de montagne humide en bordure de la route, Lambinon 74/844 (fertile). — Ibid., entre

1. Comme C. GAUDICHAUD l'indique dans sa préface, c'est Persoon qui s'est chargé de la partie descriptive relative aux champignons et lichens récoltés à l'occasion de ces expéditions. Le matériel étudié était assurément de mauvaise qualité, puisque (voir préface et note n°5 en p. 191), le bateau ayant fait naufrage et échoué aux Îles Malouines, les plantes ont «macéré» dans l'eau de mer puis ont été reséchées. Par ailleurs, de nombreux taxons de lichens (*Pyrenula*, *Porina*, *Arthonia*, *Verrucaria*, *Opegrapha*, ...) sont cités dans le paragraphe concernant les Fungi, alors que l'auteur les considère bien comme des lichens. Il doit s'agir là d'un des tout premiers essais d'intégration de la systématique des lichens au sein de celle des champignons, même si ce n'est qu'une démarche implicite. À noter aussi que *Coccocarpia viridescens* Pers., cité dans ce texte, est un nomen nudum : il n'y a ni description, ni diagnose.

Garamba et la plantation de Gisakura, env. 1900 m, fragment de forêt de montagne humide à *Mimulopsis arborescens* en bordure de la piste, sur branchettes mortes, Lambinon 74/1059 (fertile). — Vallée de la Bikeneko à l'W du poste minier de Gikungu (env. 30 km N de Rutsiro), env. 2100 m, grosses branches d'un *Neoboutonia macrocalyx*, forêt secondarisée au bord de la rivière, Lambinon 74/700 (fertile).

District du Rwanda et du Burundi : Ntyazo (région du Mayaga), env. 1400 m, fourrés xérophiles, sur branche de *Carissa edulis*, Lambinon 80/297 (stérile, très petit spécimen).

BURUNDI : District du Rwanda et du Burundi : Kinazi, crête entre la Ruvubu et la Chizanye (pointe E du Burundi vers le territoire tanzanien), env. 1400 m, sur petite branche de *Parinari curatellifolia*, savane herbeuse boisée à *Entada*, *Combretum*, *Parinari*, ..., Lambinon 78/425 (fertile). — Cankuzo, route vers Mugeru-Muroro près de la bifurcation, env. 1650 m, petite galerie forestière à *Syzygium cordatum*, *Macaranga schweinfurthii*, *Carapa*, ..., branches d'arbres abattus (vers 6-7 m de haut?), Lambinon 80/621 (fertile).

District du Mosso-Malagarasi : Plaine de la Musindozi, entre la plaine d'aviation du Gihofi et Mulamba, env. 1200 m, savane boisée à *Oxytenanthera abyssinica*, sur chaumes d'*Oxytenanthera* mort, Lambinon 74/1384 (fertile).

Matériel africain complémentaire :

ZAÏRE : Plateau de la Luweo, Yangambi, env. 470 m, forêt primitive ombrophile, sur branche maîtresse et dans la cime d'un *Klainedoxa*, Louis 6664 (BR).

Commentaires. — 1. *Coccocarpia erythroxyli* est une espèce pantropicale qui s'étend jusqu'aux régions tempérées océaniques. Dans la dition, sans être fréquent, c'est un épiphyte assez largement distribué dans pratiquement tous les milieux naturels ou peu altérés, à atmosphère suffisamment humide (forêts, savanes boisées, parfois bosquets xérophiles); elle ne dépasse toutefois pas 2100 m d'altitude.

2. Certains spécimens, en particulier le n° 72/08, ont une marge lobulée et sont munis de lobules plus ou moins laminaux. Ils correspondent à *C. pellita* var. *semiincisa* Müll. Arg. (*Flora* 65 : 321, 1882); nous les considérons comme de simples variations sans valeur taxonomique.

3. Notons que dans une étude du genre en Afrique orientale, SWINSCOW & KROG (1976 : 253) signalent *C. azurella* Nyl. du Ruwenzori. Cette espèce se distingue de *C. erythroxyli* par ses lobes beaucoup plus étroits, tronqués à l'apex, et par ses spores globuleuses.

COCCOCARPIA PALMICOLA (Spreng.) Arvidss. & D. Gall.

Bot. Not. 132 : 242, 1979.

Basionyme. — *Lecidea palmicola* Spreng., *Kunigl. Vetensk.-Academ. Nyu Handl.* 1 : 46, 1820.

Type. — Guadeloupe, in cortice *Cocos nucifera*, 1817 (lectotype, TO).

= *Coccocarpia cronia* (Tuck.) Vain. (pour plus de détails sur la synonymie, voir SWINSCOW & KROG 1976 : 253).

ZAÏRE : District forestier central : Irangi, réserve de l'I.R.S.A.C., sur la rive droite de la rivière Luhoho, env. 850 m, forêt équatoriale, sur petites branches de *Brazzea longipedicellata* vers 5 m de haut, dans le bas d'un petit versant, Lambinon 72/21 (stérile).

District du Graben occidental : Ile Idjwi, Rwagahe (côte occidentale de la partie nord de l'île), 1460 m, face latérale ± ombragée d'un gros bloc granitique éclairé en lisière de la forêt secondarisée, Lambinon 78/381 (stérile).

RWANDA : District afro-montagnard : Forêt de Rugege, colline entre le mont Muzimu et le Bigugu, au-dessus de la rivière Bizumu, 2450 m, tronc de *Syzygium parvifolium* en lisière de la forêt, Lambinon 72/1009 (stérile). — Ibid., vers le km 91 de la route Butare-Cyangugu (entre Pindura et Uwinka), environ 2400 m, talus (schiste métamorphisé «pourri») frais, en lisière de la forêt de montagne ± secondarisée, Lambinon 74/783 (stérile) et 74/784 (fertile). — Ibid., entre Garamba et la plantation de Gisakura, env. 1900 m, fragment de forêt de montagne humide à *Mimulopsis arborescens* au bord de la piste, sur branchettes mortes, Lambinon 74/1060 (fertile). — Ibid., km 81 de la route Butare-Cyangugu (un peu à l'W du marais Gasare), env. 2320 m, talus (schiste métamorphisé «pourri») en bordure de la forêt de montagne ± secondarisée, Lambinon 74/1077 (stérile). — Ibid., lieu-dit Ruwankuba, 1950 m, forêt de vallée à *Syzygium rowlandii*, sur les lianes et les rameaux ligneux couverts de bryophytes dans le sous-bois, à 1-2 m de haut, Lambinon 71/1077 (stérile). — Ibid., sur feuilles mortes de *Symphonia globulifera*, Lambinon 71/1083 (stérile).

BURUNDI : District du Rwanda et du Burundi : Kinazi (entre Cankuzo et Muhinga), env. 1400 m, grosses branches de *Parinari* dans la savane-parc de versant, Lambinon 74/1457 (stérile). — Gitwenge, colline Niabitangu (au N de la mission, pente vers la dépression du Mosso), env. 1780 m, petite galerie forestière traversant la savane dégradée, tronc ombragé de *Syzygium*, Lambinon 80/555 (stérile).

Matériel africain complémentaire :

ZAÏRE : Plateau de la Luweo, Yangambi, env. 470 m, forêt primitive ombrophile, sur branche maîtresse d'un *Tessmannia*, Louis 6565 (BR).

LA RÉUNION : Cirque de Cilaos, Grand Matarum, 1450 m, forêt des bois de couleur, sur tronc, J.L. De Sloover 17715 (NAM, LG).

Commentaires. — 1. Nous suivons ARVIDSSON & GALLOWAY (1979 : 243-244) dans leur interprétation du type de *Lecidea palmicola* Spreng. et dès lors dans la mise en synonymie de *Coccocarpia cronia*. *C. palmicola* s'avère ainsi une espèce répandue dans toutes les régions intertropicales et débordant souvent largement dans les zones tempérées des deux hémisphères. Dans notre dition, c'est une espèce trouvant manifestement son optimum dans la forêt de montagne, où elle ne dépasse toutefois pas 2450 m d'altitude. Elle colonise tant les branches et lianes du sous-bois que les talus schisteux frais; une fois elle a été notée comme une espèce pseudofollicole accidentelle.

2. Trois spécimens (Lambinon 71/1077, 71/1083 et 72/21) ont, par rapport aux autres collections, un thalle de petite taille (1-2 cm), fragile, d'une couleur plus bleutée et muni d'isidies très fines et très fragiles, cylindriques et non ramifiées; ces variations semblent dues à un habitat plus ombragé et ne justifient pas une distinction taxonomique.

COCCOCARPIA PELLITA (Ach.) Müll. Arg.*Flora* 65 : 320, 1882.**Basionyme.** — *Parmelia pellita* Ach., Lich. Univ. : 468, 1810.**Type.** — Localité inconnue, «Habitat ad truncos arborum Indiae Occidentalis» (lectotype, H-Ach.).

RWANDA : District afro-montagnard : Chaîne des Birunga, pied sud du Gahinga, 2400 m, forêt de montagne secondarisée à dominance de *Neoboutonia*, tronc incliné de *Neoboutonia macrocalyx*, Lambinon 72/657 (stérile). — Ibid., Kinigi (NW de Ruhengeri), env. 2300 m, plantation Rops, tronc d'*Eucalyptus* planté entre un chemin et des friches, Lambinon 72/711 (fertile). — Ibid., entre Kinigi et le pied du Gahinga, en contrebas de la selle entre le Sabyinyo et le Gahinga, 2400 m, forêt de montagne broussailleuse, tronc incliné de *Maesa lanceolata* var. *mildbraedii*, Lambinon 72/918 (stérile).

Commentaires. — 1. Dans la dition, cette espèce, pantropicale et occasionnellement tempérée-chaude, est limitée aux horizons supérieurs de la forêt de montagne de la chaîne des Birunga. Elle se comporte de la même façon dans les régions d'Afrique orientale étudiées par SWINSCOW & KROG (1976); par contre, en Nouvelle-Zélande, elle est observée entre 0 et 400 m d'altitude. Dans la dition, elle est toujours épiphyte, alors que, en Amérique centrale, elle est parfois épiphyllé (SANTESSON 1952 : 422).

2. SWINSCOW & KROG (1976 : 258) ont soulevé le problème de la distinction entre *C. pellita* et *C. erythroxyli*, se demandant si *C. pellita* n'est pas simplement une forme stationnelle de *C. erythroxyli*. Dans notre dition, même si ces deux espèces ne sont pas sympatriques, leur morphologie est suffisamment différente pour qu'elles soient maintenues comme distinctes. *C. pellita* possède des isidies squamuleuses, souvent très fines et incisées, tandis que *C. erythroxyli* = des isidies cylindriques, épaisses à enflées.

LOBARIA (Schreb.) Hoffm.

Deutschl. Fl. 2 : 138, 1796.

Lichen (sect. ?) *Lobaria* Schreb., Linn. Gen. Pl., éd. 8 : 768, 1791.**Espèce-type.** — *Lobaria pulmonaria* (L.) Hoffm**LOBARIA PULMONARIA** (L.) Hoffm.

Deutschl. Fl. 2 : 146, 1796.

Basionyme. — *Lichen pulmonarius* L., Sp. Plant. : 1145, 1753.**Type.** — Localité inconnue, herb. C. Linnaeus (LINN 1273. 103b, lectotype : voir YOSHIMURA & HAWKSWORTH 1970).= *Lobaria africana* Dodge (fide YOSHIMURA 1971 : 286).

ZAÏRE : District afro-montagnard : Wimbi (26 km S de Lubero), 2200 m,

horizon supérieur de la forêt de montagne, sur un gros *Conopharyngia* au-dessus d'un ruisseau, Louis 4694 (BR, LG). — Luemba, 2100 m, galerie forestière, sur bambous, Kinet 1537 (BR, LG) (cité par DES ABBAYES 1958 : 5, sub *L.p.* var. *meridionalis* (Vain.) Zahlbr.).

RWANDA : District afro-montagnard : Forêt de Rugege, versant sud du mont Muzimu (partie N de la forêt), 2720 m, forêt basse humide, branches et petits troncs moussus, Lambinon 72/946. — Gikungu (env. 30 km N de Rutsiro), versant gauche de la vallée de la Bikeneko, env. 2150 m, forêt de montagne ± secondarisée, sur la liane *Schefflera myriantha*, vers 10 m de haut, Lambinon 74/477. — Vallée de la Sebeya, à env. 4 km au sud du poste minier de Gikungu, env. 2050 m, forêt humide de fond de vallée, à épiphytisme bryophytique dense, sur liane (*Schefflera*) sur la lisière, Lambinon 74/687. — Vallée de la Bikeneko, à l'W du poste minier de Gikungu, env. 2100 m, grosse branche d'un arbre mort, dans une clairière au bord de la rivière, Lambinon 74/694. — Gisovu, Centre forestier suisse, 2200 m, forêt de montagne, sur *Prunus africana*, Troupin 14451.

Matériel africain complémentaire :

TANZANIE : Kilimandjaro-Sud, 2800 m, Gürtelwald, Flechte an Bäumen, gr. Gruppen, Schlieben 4949 (BR, LG).

LA RÉUNION : Cirque de Cilaos, Sentier du Piton des Neiges, 1450 m, forêt hygrophile des bois de couleur, épiphyte, J.L. De Sloover 17550 (NAM, LG). — Ibid., env. 2400 m, formation basse d'éricacées et de composées, entre les blocs rocheux, sur arbrisseau, J.L. De Sloover 17940 (NAM, LG).

Commentaires. — 1. Espèce répandue dans toutes les zones tempérées de l'hémisphère nord, *Lobaria pulmonaria* n'est, dans les régions intertropicales, connu que des montagnes d'Afrique orientale et méridionale et d'Amérique centrale (cartes dans YOSHIMURA 1971 : 240 et 250). Dans notre dition, ce lichen est un épiphyte croissant dans les stations les plus humides de la forêt de montagne entre 2000 et 2700 m; il y est d'ailleurs rare et n'est qu'exceptionnellement pourvu d'apothécies (seule la récolte 74/477 est fertile, d'ailleurs très peu).

2. Depuis DEGELIUS (1941 : 17), on a souvent identifié à la var. *meridionalis* (Vain.) Zahlbr. les spécimens non sorédiés mais presque uniquement isidiés de cette espèce, provenant surtout des régions tempérées chaudes de l'Europe et de Macaronésie. YOSHIMURA (1969 : 68-73) a cependant montré que *L. meridionalis* Vain. était une espèce tout à fait différente, du Sud-Est asiatique. Par ailleurs, il existe, en tout cas dans le matériel africain que nous avons examiné, un continuum complet entre les échantillons à sorédies ± isidiales et les spécimens uniquement isidiés. Certains fragments de thalles montrent d'ailleurs à la fois des sorédies à peine isidifères et des isidies s. str. Il nous paraît donc inopportun d'accorder une valeur taxonomique à cette variation.

LOBARIA RETIGERA (Bory) Trev.

Lichenotheca Veneta : 75, 1869.

Basionyme. — *Lichen retiger* Bory de St Vincent, Voyage dans les Quatre Principales Iles des Mers d'Afrique 1 : 392 et 3 : 101, 1804.

Type. — La Réunion, Richard s.n. (lectotype, M; voir YOSHIMURA 1971 : 299-300).

= *Lobaria natalensis* Räs. (fide YOSHIMURA 1971 : 299).

ZAÏRE : District afro-montagnard : Massif du Kahuzi, env. du km 41 de la route Bukavu-Walikale, 2300 m, forêt de montagne mêlée de bambous, sur versant escarpé, branches maîtresses couvertes de mousses, fougères et orchidées d'un arbre tombé, Lambinon 71/1180 (stérile). — Ibid., lieu-dit Mukaba (km 49 de la route Bukavu-Walikale), 2250 m, tronc ombragé d'*Eucalyptus* en bordure d'une plantation, Lambinon 72/66 (stérile). — Mont Biega, piste du versant sud, 2520 m, branche horizontale dans la forêt mélangée de bambous, Lambinon 72/92 (fertile).

RWANDA : District afro-montagnard : Chaîne des Birunga, versant sud du Sabyinyo, 2250 m, forêt de montagne mêlée de bambous, grosse branche morte, Lambinon 72/450 (stérile). — Forêt de Rugege, km 67 de la route Butare-Cyangugu, 2350 m, talus terreux frais très raide à proximité de la route, Lambinon 72/1059 (stérile). — Ibid., vers le km 91 de la route Butare-Cyangugu (entre Pindura et Uwinka), env. 2400 m, talus (schiste métamorphisé «pourri») frais, en lisière de la forêt de montagne ± secondarisée, Lambinon 74/777 (stérile). — Ibid., vers le km 105 de la route Butare-Cyangugu, env. 1950 m, talus frais moussu (schiste métamorphisé «pourri») en lisière de la forêt de montagne, Lambinon 74/826 (stérile). — Ibid., entre Garamba et la plantation de Gisa-kura, env. 1900 m, talus embroussaillé, piste en bordure de fragments de forêt de montagne, Lambinon 74/1049 (stérile). — Ibid., collines entre le mont Muzimu et le Bigugu, 2380 m, branches de la cime d'*Apodytes dimidiata* dans la forêt de montagne, Lambinon 72/979 (stérile). — Ibid., lieu-dit Ruwankuba, 1950 m, forêt de vallée à *Syzygium rowlandii*, sur les lianes et les rameaux ligneux couverts de bryophytes dans le sous-bois, à env. 1-2 m de haut, Lambinon 71/1066 (fertile). — Forêt de Nyungwe, km 5 de la piste Pindura-Bweyeye, env. 2050 m, branches de *Cassipourea*, vers 11 m de haut, dans la forêt de montagne de versant, Lambinon 74/864 (stérile). — Ibid., km 22 de la piste Pindura-Bweyeye, env. 1750 m, branche d'un arbre mort (*Bersama* ?) dans la forêt de montagne près de la rivière Shabwa, Lambinon 74/996 (stérile). — Env. de la commune de Rugera (SE de la préf. de Gikongoro), colline Uwintashya, env. 2400 m, dans le bas d'un tronc de *Macaranga* dans la forêt de bambous, Lambinon 74/1122 (stérile) et 74/1123 (fertile). — Ibid., vallon Uwagahunga, env. 2350 m, sur tronc de *Rapanea*, fourré au bord du ruisseau, Lambinon 74/1165 (stérile). — Gikungu (env. 30 km N de Rutshiro), env. 2200 m, talus argileux raide, en bord de piste, dans la forêt de montagne secondarisée, Lambinon 74/432 (stérile). — Ibid., versant gauche de la vallée de la Bikeneko, env. 2150 m, forêt de montagne ± secondarisée, sur branches de *Gonopharyngia*, vers 6 m de haut, Lambinon 74/464 (stérile). — Vallée de la Sebeya, à env. 3 km au sud du poste minier de Gikungu, env. 2050 m, grosse branche de *Nuxia floribunda* vers 10 m de haut, Lambinon 74/677 (stérile). — Ibid., à env. 4 km au S du poste minier de Gikungu, env. 2050 m, forêt humide de fond de vallée à épiphytisme bryophytique dense, sur liane (*Schefflera*) dans le sous-bois sombre,

Lambinon 74/688 (stérile). — Ibid., à l'W du poste minier de Gikungu, env. 2100 m, forêt de bas de versant à sous-bois dense d'*Acanthaceae* buissonnantes, sur le sol riche en débris végétaux, Lambinon 74/708bis (stérile). — Forêt de Gishwati, au km 39 de la route Gisenyi-Kibuye, 2150 m, talus grésio-terreux frais et raide de la route, Lambinon 72/515 (stérile).

BURUNDI : District afro-montagnard : Forêt de Bururi, env. 2100 m, forêt de montagne à *Entandrophragma* sur sol subhorizontal, branches tombées, Lambinon 74/1299 (stérile). — Massif du Mont Teza, crête au-dessus de la plantation de thé, env. 2500 m, forêt de montagne ± secondarisée, dans le bas d'un tronc de *Macaranga*, Lambinon 74/1407 (stérile). — Ibid., Bugarama, env. 2100 m, forêt de montagne, sur tronc de *Macaranga*, Petit 2407 (stérile) (BR, LG).

Matériel africain complémentaire :

ZIMBABWE (ex Rhodésie) : Mts Vumba, Leopard Rock, 1600 m, rochers éclairés dans la forêt, Bamps, Symoens et Vanden Berghen s.n. (stérile) (LG). — Inyanga, Mimunzi, vers 1900 m, épiphytes dans la forêt, Bamps, Symoens et Vanden Berghen s.n. (stérile) (deux collections, LG). — Inyanga, Inyangani, vers 2070 m, sur *Leucosidea*, Bamps, Symoens et Vanden Berghen 460d (stérile) (LG).

LA RÉUNION : Cirque de Cilaos, Grand Matarum, 1500 m, sur tronc, J.L. De Sloover 17452 (fertile) (NAM, LG). — Ibid., Sentier du Piton des Neiges, env. 1950 m, formation à *Philippia* et composées, sur blocs rocheux, J.L. De Sloover 17659 (stérile) (NAM, LG). — Près du sommet de la Grande Montée, env. 1550 m, forêt des bois de couleur, sur gros troncs, J.L. De Sloover 17334 (stérile) (NAM, LG).

Commentaires. — Espèce caractéristique de la forêt de montagne entre 1900 et 2500 m d'altitude, où, à l'état épiphyte ou terricole, elle occupe des stations humides et ombragées. Elle est nettement plus abondante que la précédente et est occasionnellement fertile. Mises à part quelques localités signalées sur les côtes du nord-ouest de l'Amérique du Nord, c'est une espèce paléotropicale, limitée en Afrique aux montagnes orientales et méridionales (carte dans YOSHIMURA 1971 : 254).

LOBARIA SUBLAEVIS (Nyl.) Yoshim.

J. Hattori Bot. Lab. 34 : 315, 1971.

Basionyme. — *Ricasolia sublaevis* Nyl., in KREMPELH., *Flora* 51 : 231, 1868.

Type. — Madère, G. Mandon 30 (lectotype, H-Nyl. 33386).

ZAÏRE : District du Graben Occidental : Angi (7 km W de Rutshuru), plaine de lave, sur arbuste, Bequaert 5734 (BR, LG).

Commentaires. — Le spécimen examiné correspond parfaitement à la description de YOSHIMURA (1971 : 316-317) si ce n'est que le tomentum de la face inférieure est souvent bien développé. Signalée d'Extrême-Orient, où elle est abondante, de La Réunion et de Madère, cette espèce semble nouvelle pour

l'Afrique continentale. Elle n'est connue que d'une seule localité dans la plaine de la Rutshuru.

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NOTE

OCTOBLEPHARUM ERECTIFOLIUM MITT. ex WILLIAMS
 ET STEEREOBRYON SUBULIROSTRUM (SCHIMP. ex BESCH.)
 G.L. SMITH EN GUADELOUPE

J.L. DE SLOOVER*

1. *Octoblepharum erectifolium* Mitt. ex Williams

a) Guadeloupe, Basse-Terre, chemin bordant le Grand Étang, 400 m, forêt dense avec Gommiers et Bambous, épiphyte sur gros tronc, 15 avril 1981, J.L. De Sloover 33884 (NAM, PC).

b) Suivant DE FOUCAULT (1977 : 23), deux espèces d'*Octoblepharum* sont connues en Guadeloupe, à savoir *O. albidum* Hedw. et *O. pulvinatum* (Dozy & Molk.) Mitt., toutes deux assez communes dans leur étage respectif. Suivant FLORSCHÜTZ (1964 : 107), *Octoblepharum erectifolium* est connu de la Jamaïque, de Trinidad, de la Guyane anglaise et du Surinam. Sa présence en Guadeloupe n'a donc rien d'étonnant.

Octoblepharum erectifolium, suivant le même auteur, est caractérisé par ses feuilles très longues (jusque 2 cm), très fragiles, avec une section transversale à mi-hauteur aussi épaisse que large (semi-circulaire ou triangulaire équilatérale à angles arrondis). La récolte de la Guadeloupe correspond fort bien à la description et à l'illustration que donne FLORSCHÜTZ.

2. *Steereobryon subulirostrum* (Schimp. ex Besch.) G.L. Smith

a) Guadeloupe, Basse-Terre, La Soufrière, chemin des Dames (piste jaune), sur le sol, 10 avril 1981, J.L. De Sloover 33833 et 33838 (NAM, PC).

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b) Le genre *Steereobryon* est nouveau pour la Guadeloupe, où on ne connaissait, de la famille des Polytrichaceae, que *Pogonatum tortile* (Sw.) Brid., espèce très commune et citée sous de nombreux synonymes (DE FOUCAULT 1977 : 18).

Atrichum subulirostrum Schimp. ex Besch. et *A. portoricense* Crum & Steere ont été mis en synonymie par SMITH, qui a créé pour cette espèce le genre *Steereobryon* (1971 : 56). NYHOLM (1971) gardait encore les deux espèces séparées. Les deux récoltes citées ici, dont la seconde est fertile, confirment la mise en synonymie proposée par SMITH. On trouvera des descriptions et des illustrations de cette espèce dans CRUM & STEERE (1957), FRYE (1948), NYHOLM (1971) et SMITH (1971).

Steereobryon subulirostrum était connu du Mexique, de la Jamaïque, de Haïti, Porto Rico, le Venezuela et la Colombie (SMITH 1971 : 56). La Guadeloupe s'inscrit naturellement dans cette répartition.

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- fasc. 2, 28 juin 1971, xiv, (v-xliii), 171-566
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- fasc. 7, 31 déc. 1978, xvii, (xxxix-xliv), 1547-1752
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Monte G. MANUEL est subitement décédé le 8 juin 1981, à Nairobi, Kenya.

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B. calcarata (Sde Lac.) Schiffn., *B. stresemannii* (Herz.) c.n. (= *Mastigobryum* s.), *B. asymmetrica* (Steph.) c.n. (= *Mast. a.*), *B. subaequitexta* (Steph.) c.n. (= *Mast. s.*) de Nouvelle-Guinée.

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HUAULT Cl. — Contrôle par le phytochrome de la germination des propagules de *Lunularia cruciata* L. *Compt.-Rend. Hebd. Séances Acad. Sci., Sér. D* 1980, 291, 2 : 307-310, 6 fig., tabl. (Centres Rech. Biol. & Physiol. Cell., Lab. Photobiol., LA. CNRS n° 203, Fac. Sci., F-76130 Mont-Saint-Aignan).

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9 taxons sont étudiés. Premier comptage pour *Fissidens rambii* Gang. (n = 10), *F. curvatoxiphioides* Dix. et P. Vard. (n = 10), *F. curvatoinvolutus* Dix. (n = 12), *F. biformis* var. *subbryoides* Mitt. (n = 10).

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Descr. des associations. Écosociologie de cert. esp.; mousses, lichens, phanérogames cités. Observ. de toundra de mousses : comparaison entre la communauté «sèche» à *Sphagnum squarrosum* et *Hypnum revolutum* et la communauté «humide» à *Drepanocladus revolvens* et *Deschampsia alpina*. Noter la trouvaille de larges tapis de *Racomitrium lanuginosum*.

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Arunachal (ex NEFA), Assam, Nagaland, Manipur, Tripura, Bangal W, Bihar et Orissa avec les régions naturelles adjacentes : Sikkim, Bhutan, Népal et Bangladesh; s'y ajoutent les îles Andaman et Nicobar et une petite partie du Madhya Pradesh. Cette monographie, qui veut servir de base à des recherches futures, recouvre 990 esp. réparties en 274 genres et 52 familles. Descr. des familles et des genres. Clés aux genres et esp. Taxonomie, descr., ill., distr. régionale et mondiale de chaque esp. Notes cytologiques (nombres chromosomiques et investigateurs) par genres. Les données géographiques par genre, et un index taxonomique complètent cette importante monographie, qui est parue en 8 fascicules de 1969 à 1980. Ce travail, unique pour l'Inde orientale, bien illustré, se présente comme un bon outil de référence. Taxons nouv. : *Atrichum longifolium* Card. et Dix. ex Gang. - 1969, *Calyptothecium dixonii* Gang. - 1976, *Daltonia decolyi* Broth. ex Gang. - 1977, *Distichophyllum decolyi* Gang. - 1977, *Fissidens allanii* Gang. - 1971, *F. rambii* Gang. - 1971, *F. rigidiusculus* Broth. in Bruehl ex Gang. - 1971, *Isopterygium andamanicum* Gang. - 1980, *Leucophanes nicobaricum* C. Müll. ex Gang. - 1971, *Neckeropsis darjeelingensis* Gang. - 1976, *Orontobryum recurvum* Gang. - 1977, *Penzigiella hookeri* Gang. - 1976, *Pohlia ampullacea* Gang. - 1974, *Schoenobryum concavifolium* (Griff.) Gang. - 1976 (= *Orthotrichum*), *Splachnobryum bengalense* Gang. - 1974, *Thamnobryum fruticosum* (Mitt.) Gang. - 1976 (= *Neckera*), *T. macrocarpum* (Brid.) Gang. - 1976 (= *Neckera*), *Thyridium andamense* Besch. ex Gang. - 1972, *T. nicobaricum* Broth. ex Gang. - 1972, *Trichosteleum punctipapillosum* Par. ex Gang. - 1980, *T. stereodontoides* Broth. ex Gang. - 1980. (Les dates de parution des différents fascicules sont indiquées dans la partie « Informations » du présent fascicule).

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GADEA E. — La distribució de la nematofauna muscícola i liquenícola als illots del País Valencià. *Treb. Inst. Catalana Hist. Nat.* 1981, 9 : 69-73, 1 fig. (Dept. Zool., Fac. Biol. Univ. Barcelona, España).

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7 esp. sont reconnues appartenir au groupe *Cladonia gracilis* : *C. macroceras* (Delise) Ahti, *C. maxima* (Asah.) Ahti et *C. squamosissima* (Müll. Arg.) Ahti c.n. (= *C. gracilis* var. s.) sont confinés à l'hémisphère nord, et *C. subchordalis* A.W. Evans à l'hémisphère sud, tandis que *C. cornuta* (L.) Hoffm., *C. ecmocyna* Leighton et *C. gracilis* (L.) Willd. ont une distribution bipolaire. *C. gracilis* est divisé en 6 sous-esp. : ssp. *elongata* (Jacq.) Vainio, ssp. *gracilis*, ssp. *nigripes* (Nyl.) Ahti c.n. (= *C. ecmocyna* f. *nigr.*), ssp. *tenerrima* ssp. nov. d'Australie, ssp. *turbinata* (Ach.) c.n. (= *Lichen t.*), et ssp. *vulnerata* ssp. nov. d'Alaska. *Cladonia cornuta* comprend 2 sous-esp. : ssp. *cornuta* et ssp. *groenlandica* (E. Dahl) c.n. (= *C. cornuta* var. g.). *C. ecmocyna* est divisé en ssp. *ecmocyna* et ssp. *intermedia* (Robbins) c.n. (= *C. elongata* f. i.). *C. propagulifera* (Vainio) Dodge est syn. avec *C. gracilis* ssp. *gracilis*. *C. gracilis* var. *dilatata* (Hoffm.) Vainio est remplacé par *C. gracilis* ssp. *turbinata*. Noter parmi les taxa exclus : *C. campbelliana* (Vainio) Gyelnik, *C. isabellina* Vainio et *C. cornuta* f. *subdilatata* Asah. Présence de types morphol. intermédiaires entre les sous-esp. de *C. gracilis*, comparables aux hybrides locaux chez les plantes supérieures. Clé aux taxons. Pour chaque taxon : taxonom., descr., chimie, ill., spécim. examinés. La plupart des taxons contiennent les acides fumarprotocétrarique et protocétrarique, quelques-uns de l'atranorine. Nouv. substances isolées : ac. squamatique chez *C. subchordalis* et ac. grayanique chez *C. isabellina*. Noter encore la récolte de *C. alinii* Trass. en Alaska, nouv. pour l'Amérique du Nord.

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lichens lirellocarpes et aux lichens discocarpes crustacés. Révision de 64 genres et de *Parmelia* subgen. *Melanoparmelia*. Descr. du genre, clé aux esp. (avec descr., chimie et syn.) et bibliographie. Corrections et additions au 1^o supplément. Corrections et nouveautés taxonomiques du 2^o supplément; on notera : 28 comb. nouv., diagn. de *Melanolecia* Hertel gen. nov. (esp. type : *M. transitoria* (Arnold) c.n. (= *Lecidea*) et de *Lecanora mugosphagneti* Poelt et Vězda, de Bavière, ex aff. *Lecanora pallidae*. Index pour les 2 suppléments.

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47 esp. de *Cladonia* et *Cladina* des Mts Anyui. 12 sont nouv. pour la région de Chukotka. Comparaison avec les flores de l'holarctique N. Comparaison des esp. d'un habitat à l'autre. Utilisation de l'index Goodal.

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POLLUTION

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Suggestion : la sensibilité des lichens à la pollution atmosphérique serait liée au degré de dépendance du mycobionte vis-à-vis du phycobionte, aussi longtemps que l'énergie métabolique est concernée.

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3 méthodes sont utilisées et comparées pour doser les composés fluorés : dosage des thalles de *Xanthoria parietina* in situ et nécrosés, étude des transplants de *Xanthoria parietina* et *Parmelia caperata* pendant 6 mois, étude phytosociol. des épiphytes de Peupliers dans 35 sites (IAP).

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16 fig., 1 tabl. (Dept. Bot., Univ. Oulu, Box 191, SF-90101 Oulu 10).

Descr. de la méthode d'investigation avec *Hypogymnia physodes* (L.) Nyl. comme matériel. Cette méthode permettrait d'étudier les changements apportés aux lichens par la pollution atmosphérique, et l'estimation des conditions de vie de la couche cellulaire algale.

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Les lichens corticoles semblent accumuler plus rapidement le fluor que les saxicoles, d'où des dégâts accélérés et une réduction en nombre plus importante. Rôle du vent et de la distribution par rapport à l'usine. Évolution de la population lichénique entre 1970 et 1978.

VARIA

BRUNEAU D. — Regards sur l'étude des Muscinées et des Lichens en Anjou. *Mém. Soc. Étud. Sci. Anjou «1980»* 1981, 4 : 165-169 (44 rue du Pin, 49000 Angers).

Historique des récoltes et herbiers depuis 1800. Courtes notices des principaux bryologues et lichénologues qui travaillèrent sur la région.

HAWKSWORTH D.L. — Notes on some fungi occurring on *Peltigera*, with a key to accepted species. *Trans. Brit. Mycol. Soc.* 1980, 74, 2 : 363-386, 11 fig. (CMI, Kew Surrey TW9 3AF, Great Britain).

Clé aux 40 champignons exclusivement lichénicoles et notes pour 16 d'entre eux. Le fait que tant d'esp. soient exclusives à ce genre d'hôte et que 6 genres soient monotypiques, suggère que *Peltigera* représente un groupe particulièrement ancien parmi les Lecanorales. Noter les gen., sp. et comb. nov. parmi les champignons lichénicoles.

HERTEL H. — Index collectorum Lichenum Herbarii Monacensis. Ein Sammler-Verzeichnis des Flechtenherbars der Botanischen Staatssammlung München. *Mitt. Bot. Staatssamml. München* 1980, 16 : 333-462 (Bot. Staatssamml., Menzinger Str. 67, D-800 München 19).

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MOXHAM T.H. — Lichens in the Perfume Industry. *Dragoco Rep.* 1981, 2 : 31-39, 3 fig., phot. coul. (Dept. Pl. Sci., Univ. Bath, Claverton Down, Bath BAZ 7AY, Great Britain).

Evernia prunastri (Oakmoss, mousse de chêne) et *Pseudevernia furfuracea* (mousses d'arbre) sont les plus menacés : 7800 à 9200 tonnes par an sont récoltées pour l'industrie du parfum, au Maroc, en Yougoslavie (principalement), en France. Destruction des sites par élimination d'autres esp. telles *Ramalina* et *Usnea*.

RENNER B. und GERSTNER E. — Mediumabhängige Anthrachinon-Bildung in Mycobiontenkulturen von *Caloplaca ferruginea*. *Naturwissenschaften* 1980, 67, 7 : 352-353, 2 fig. (Fachber. Biol. & Chem., Univ., D-3550 Marburg).



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compilé par D. LAMY

Il ne figure que la première page de l'article dans lequel est cité la taxon. Les nouveautés taxonomiques sont indiquées en italiques. Les taxons cités en synonymie ou comme basionymes sont indiqués par "syn." ou "bas.". Lorsque le numéro de page est suivi d'un nom de région, le taxon est considéré comme nouveau pour celle-ci (ex. *Acaulon triquetrum*, 289 Navarre).

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